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in the Fields of

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Metallurgy

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NP-3314	Electronic Devices for Nuclear Physics; Quarterly Report; April 1951 – July 1951. G. A. Morton, Director.	5744
NP-3320	A Dekatron Scale of 400 (Topical Report TR-89/51). J. C. Baker and G. G. Eichholz.	5747
NP-3321	Organization of the Norwegian-Dutch Nuclear Reactor Program. S. Fred Singer.	5871
NRC-2358	Beta-ray Thickness Gauges (Divisional Report No. PR-90). W. R. Dixon.	5742
PA-10	A General Purpose Photoelectric Tricolorimeter. H. F. Pollard.	5748
RAE-R-MET-64	X-ray Diffraction Studies in Relation to Creep. Catherine M. Luff and Edna M. Smith.	5668
RAE-TN-MET-130	The Thermal Expansion Coefficients of Chromium, Titanium, and Zirconium Carbides. J. A. Graham.	5665
RAE-TN-MET-141	Alloys of Titanium with Oxygen and Nitrogen. D. A. Sutcliffe.	5667
TEI-132 (pt. 1)	Abstracts of the Literature on Synthesis of Apatites and Some Related Phosphates; Part I. Elizabeth B. Jaffe.	5682
TEI-142	Distribution of Uranium in Rich Phosphate Beds of the Phosphoria Formation. M. E. Thompson.	5683

GENERAL

ATOMIC POWER

5450

INDUSTRIAL AND SAFETY PROBLEMS OF NUCLEAR TECHNOLOGY. Morris H. Shamos and Sidney G. Roth, eds., New York, Harper & Brothers. 368p.

Technological problems and dangers peculiar to the development of atomic power that were discussed at a three-day conference sponsored jointly by the Atomic Energy Commission and New York University's Division of General Education are presented in this book. Authors of the papers are 21 leaders in the fields of industrial development, nuclear research, radiation medicine and casualty insurance. A more complete abstract appears in Steel 128, No. 23, 141-2(1951) June 4.

BIOLOGY AND MEDICINE

5451

Argonne National Lab.

DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; QUARTERLY REPORT, AUGUST, SEPTEMBER, OCTOBER, 1950. Austin M. Brues, Director. [nd] 199p. (ANL-4531)

Separate abstracts have been prepared on the following sections of this report: Effects of External X Irradiation, p.14-63, 107-19; 126-42, 177-82; Progress Report: Effects of Different Fixatives on Connective Tissue as Observed in the Electron Microscope, p.64-71; Toxicology, p.72-106, 120-2, 157-62, 183-91; Progress Report: β-Irradiation Effects from Diffuse and Point Sources of Sr^{90}, p.123-5; The Effect of X Irradiation on the Absorption Spectra of Adenosine Triphosphate, Pyridine Nucleotide, and Nucleic Acids, p.143-52; Determination of Na and P in Bone by Neutron Activation Analysis, p.153-5; Progress Report: Ionization in Air from Beta-Ray Point Sources, p.163-7, and Progress Report; Concentration Measurements of Freon by an Ionization Method, p.169-76.

5452

Argonne National Lab.

EFFECTS OF DIFFERENT FIXATIVES ON CONNECTIVE TISSUE AS OBSERVED IN THE ELECTRON MICROSCOPE; PROGRESS REPORT, p.64-71 of DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; QUARTERLY REPORT, AUGUST, SEPTEMBER, OCTOBER, 1950. F. Wassermann and Barbara Massey. [nd] 8p. (ANL-4531(p.64-71))

Photomicrographs and electron micrographs showing the different effects on the fibrils and ground substance in mouse connective tissue of neutral formalin, Carnoy, Bouin, and Susa fixatives are shown. 6 figures.

5453

Atomic Energy Project, Univ. of Rochester

QUARTERLY TECHNICAL REPORT; JANUARY 1, 1951, THROUGH MARCH 31, 1951. Henry A. Blair, Director. May 9, 1951. 120p. (UR-164)

Separate abstracts have been prepared on the following sections of this report: Biological Effects of External Radiation (X Rays and γ Rays), p.13-33; The Radium Content of Milk, p.34-7; Uranium [Toxicity], 38-54; Beryllium [Toxicity], p.55-72; Toxicity of Some Fluoride Compounds, p.73-7; Tracer Chemistry, p.78-89; Activities of Samples of Precipitation Following Nevada Tests, p.90-5; and Instrumentation, p.96-114.

5454

Atomic Energy Project, Univ. of Rochester

INSTRUMENTATION, p.96-114 of QUARTERLY TECHNICAL REPORT; JANUARY 1, 1951, THROUGH MARCH 31, 1951. Henry A. Blair, Director. May 9, 1951. 19p. (UR-164 (p.96-114))

Commercially available G-M tubes filled only with CO_2 gas have been shown to be satisfactory for small-sample C^{14} counting if a gated Vyverberg quenching circuit is used. As an aid to interpretation of future experiments on the effects of x radiation on specific organs of the dog, a series of depth dose measurements on a water phantom dog has been started. The depth dose expressed as per cent free air dose as a function of the vertical depth beneath the surface of the water phantom is shown. Techniques for preparation of tissue sections for the electron microscope which are intended to increase resolution and improve reproducibility of tissue sections are described; photographs of cells from the germinal epithelium of normal rat testis at 2400, 7200, and 14,000× illustrate the results obtained.

5455

Hanford Works

RETENTION BY MICE OF TRITIUM ADMINISTERED AS THE OXIDE. R. C. Thompson. June 19, 1951. 14p. (HW-21494)

Tritium oxide was administered to mice by intraperitoneal injection. The retention of tritium activity in the body water and in the dry carcass was determined. The biological half life of body water in the mouse is approximately 1.1 days.

The curve of tritium loss from the tissue-bound state can be fairly well resolved into components of 9-day and 90-day half lives. These components are thought to represent, respectively, groups of relatively dynamic body constituents, and of relatively stable body constituents. They are of comparable tritium binding capacity and under chronic exposure to tritium would accumulate about 17% as much activity as would be present in the body water. (auth)

5456

Atomic Energy Project, Univ. of Rochester
QUARTERLY TECHNICAL REPORT; APRIL 1, 1951, THROUGH JUNE 30, 1951. Henry A. Blair, Director. July 31, 1951. 131p. (UR-174)

Separate abstracts have been prepared on the following sections of this report: Biological Effects of External Radiation [X Rays and γ Rays], p.13-51; Biological Effects of External Radiation [Flash Burns], p.52-103; Beryllium [Toxicity], p.104-20.

5457

Atomic Energy Project, Univ. of Rochester
BIOLOGICAL EFFECTS OF EXTERNAL RADIATION [FLASH BURNS], p.52-103 of QUARTERLY TECHNICAL REPORT; APRIL 1, 1951, THROUGH JUNE 30, 1951. Henry A. Blair, Director. July 31, 1951. 52p. (UR-174 (p.52-103))

A modification of the carbon arc as a source for reproducible high-intensity, short-duration burns is described. A series of small-area burns of graded severity was produced in the anesthetized Chester White pig. Using a 1-sec exposure, it was found that 1.5 cal/cm^2 failed to produce a burn, whereas 3 cal/cm^2 produced an erythema which was evident 24 hr after burning, 5.5 cal/cm^2 a burn with patchy coagulation, 8.5 cal/cm^2 a burn with complete surface coagulation, and 21 cal/cm^2 a lesion with superficial carbonization. Histological study demonstrated that burns showing only erythema at 24 hr had injury confined to the epidermis. In burns with surface coagulation or carbonization, injury was trans-epidermal. Studies of the effects of various fabrics and fabric combinations protecting the skin of the anesthetized Chester White pig from flash burning were carried out. The effects of changing the color and moistening certain of the fabrics were tested. The effect on the fabric itself was not a good indication of the changes in the animal's skin. In all experiments, burns occurred when there was no apparent damage to the surface of the material touching the animal. A device constructed for the removal of uniform samples of animal skin with minimal alteration of its chemical and physical structure is described.

5458

Western Reserve Univ. School of Medicine
ADAPTATION OF A FILTRATION TECHNIQUE TO THE FRACTIONATION OF TISSUE PHOSPHORUS COMPOUNDS IN P^{32} STUDIES. Paul S. Lavik, Helen Harrington, and G. Warren Buckaloo. July 1, 1951. 25p. (NYO-1625)

In the isolation of the acid-soluble, phospholipid, ribonucleic acid + phosphoprotein, and desoxyribonucleic acid fractions from 100- to 500-mg tissue samples, it was desirable in experiments employing P^{32} to extract each fraction exhaustively and thereby minimize cross-contamination between fractions. This could be done with a considerable saving of time and without loss of accuracy by use of filtration instead of centrifugation in many steps of the procedure. A detailed description of the method and experimental evidence for its reliability are presented. (auth)

5459

Atomic Energy Project, Univ. of Calif., Los Angeles
THE EFFECT OF TOPICALLY APPLIED ERGOT ALKALOIDS ON THE MAMMALIAN CAPILLARY BED. Thomas J. Haley and Margaret R. Andem. Sept. 13, 1951. 11p. (UCLA-155)

The peripheral vascular effects of the natural and hydrogenated ergot alkaloids have been investigated on the rat mesoappendix preparation. It has been demonstrated that all these alkaloids, except ergonovine and methylergonovine, have vasoconstrictor and adrenergic blocking effects. The drugs were rated as vasoconstrictors in the following order of decreasing potency: Hydergine, ergokryptine, dihydroergokryptine, ergotamine, dihydroergocornine, ergosine, ergocornine, dihydroergocristine, ergocristine, and dihydroergotamine. The drugs were rated as adrenergic blocking agents in the following order of decreasing potency: ergotamine, ergokryptine, ergocornine, Hydergine, dihydroergocornine, dihydroergocristine, ergocristine, ergosine, dihydroergokryptine, and dihydroergotamine. The peripheral locus of action of these drugs is on the precapillary sphincters and terminal arterioles. (auth)

5460

Tennessee Univ.
QUARTERLY PROGRESS AND WORK ACCOMPLISHMENT REPORT FOR QUARTER ENDING JUNE 30, 1951; AGRICULTURAL RESEARCH PROGRAM. June 30, 1951. 13p. (ORO-43)

Administrative information and brief summaries of progress during this period are presented. No activity was detected in tissues of sheep given Ta^{182} labeled K tantalate orally, indicating less than 0.18×10^{-7}% of the dose per gram of tissue. Data on fecal excretion of orally administered La^{140} by a cow in the third month of lactation are given; no activity was detectable in blood or milk. Changes in serum and milk activity with time in a cow injected intravenously with 15 mc of Ca^{45} 3 weeks previous to parturition are listed.

5461

Argonne National Lab.
QUARTERLY REPORT NOVEMBER, DECEMBER 1950 AND JANUARY 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH. Austin M. Brues, Director. [nd] 150p. (ANL-4571)

Separate abstracts have been prepared on the following sections of this report: [Radiation Effects on Tumors], p.17-20, 48-57; [Physiological Effects of X Radiation], p.21-4, 28-9, 58-9, 94-100, 106-25; [Measuring Techniques], p.25-7, 126-39; [Radiation Protection], p.30-46; [Cytological Effects of Radiation], p.64-70, 79-88, 93; [Synthesis of Labeled Formaldehyde], p.71-5; and [Toxicology Studies], p.101, 103-5.

5462

RADIOISOTOPE PROCEDURES WITH FARM ANIMALS—I. Sam L. Hansard. Nucleonics 9, No. 1, 13-25(1951) July.

Functional metabolism units are described for radioisotope balance studies with either sex of such farm animals as swine, sheep, and cattle. Construction details and adaptability information are given. 12 figures.

RADIATION EFFECTS

5463

Biological Lab., Cold Spring Harbor, New York
GENETIC CHANGES IN POPULATION UNDER IRRADIATION. Bruce Wallace and J. C. King. [nd] 19p. (AECU-1442)

A general account is given of studies made on experimental populations of Drosophila melanogaster which are exposed to radiations. A consideration of the frequencies of lethals, semilethals, and subvitals within the populations and of the estimates of the adaptive values of the populations suggests that heterotic gene combinations have been developed within some of these populations. The bearing

these results have on estimation of radiation damage resulting from gene mutation is briefly mentioned. (auth)

5464

Atomic Energy Project, Univ. of Rochester

BIOLOGICAL EFFECTS OF EXTERNAL RADIATION (X RAYS AND γ RAYS), p.13-33 of QUARTERLY TECHNICAL REPORT; JANUARY 1, 1951, THROUGH MARCH 31, 1951. Henry A. Blair, Director. May 9, 1951. 21p. (UR-164 (p.13-33))

The urinary excretion of 17-ketosteroids was assayed in 8 dogs following exposure to a minimal lethal dose (350 r) of total-body x radiation. There was no characteristic alteration of 17-ketosteroid excretion noted. In addition, urinary 17-ketosteroid determination was found to be an unsatisfactory measure of adrenocortical activity in dogs. Routine blood cultures were obtained pre- and postirradiation from control and antibiotic- (aureomycin, streptomycin, and terramycin) treated dogs which received 450 r of total-body x irradiation. The incidence of positive blood cultures did not increase following irradiation and was the same in treated dogs as in control dogs. Autopsy cultures showed that E. coli was recovered more frequently from control dogs, whereas Staphylococci, Proteus, and Pseudomonas were recovered more frequently from treated dogs. A series of glucose tolerance tests were made on 10 dogs which received 450 r of total-body x radiation. No significant difference in the configuration of the tolerance curve occurred between the 5 dogs that died within 3 weeks and those that survived. The curve was lower in all the dogs during the first 3 days postirradiation. On the 20th and 21st days postirradiation a marked lowering of the 3rd- and 4th-hr values was found. A reciprocal relation between the serum inorganic phosphate level and glucose level was noted with no significant variation caused by the irradiation.

5465

Argonne National Lab.

EFFECTS OF EXTERNAL X IRRADIATION, p.14-63, 107-19, 126-42, and 177-82 of DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; QUARTERLY REPORT, AUGUST, SEPTEMBER, OCTOBER, 1950. Austin M. Brues, Director. [nd] 86p. (ANL-4531(p.14-63, 107-19, 126-42, 177-82))

Regressions of a mouse lymphosarcoma following various schedules of tumor and whole-body x irradiation are listed, inhibition of mitosis in spermatogonia of mice exposed to a 50-r total-body x irradiation is shown, and eye damage in mice exposed to 200 to 900 r of x rays is illustrated. Data on the blood changes in guinea pigs following 220 to 420-r x irradiations are presented graphically. Use of the mass spectrometer in analyzing the expired air of irradiated rats is described. The effects of surgical insertion of fresh spleens into the peritoneal cavity on survival of mice exposed to 1025 r of x rays are reported, and the question of spleen shielding action is discussed at some length. Late irradiation effects (tumors, cataracts, etc.) in cysteine-protected mice are noted. Effects on population growth of Chilomonas paramecium of up to 90,000 r of x rays are discussed. The effect of prior x irradiation on promoting the growth of mouse-tumor transplants in rats is indicated. The protection afforded x-irradiated mice by prior injection of methylene blue is demonstrated. Variations in inorganic P in 25,000 r irradiated grasshopper embryos are noted briefly. Lethality data on rabbits exposed to daily doses of 40 to 325 r of x rays and depression of uric acid excretion by chicks following a 1000-r radiation are tabulated. The degree of cell protection afforded by N_2/CO_2 (anaerobiosis) treatment at the time of radiation and the effect of such treatment on the postdiapause development of the grasshopper embryo are discussed. Brief reports of the effects of 1200 to 1950 r of x rays on the fighting behavior of mice and a method of artificial insemination of mice with sperm cells irradiated in vitro are included.

5466

Argonne National Lab.

β-IRRADIATION EFFECTS FROM DIFFUSE AND POINT SOURCES OF Sr^{90}; PROGRESS REPORT, p.123-5 of DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; QUARTERLY REPORT, AUGUST, SEPTEMBER, OCTOBER, 1950. Janet V. Passonneau and Katherine Hamilton. [nd] 3p. (ANL-4531(p.123-5))

Effects on the skin of rats exposed for 48 hr to Sr^{90}-impregnated paper or to glass beads containing Sr^{90} are described. The total doses were either 5900 or 8834 r of β radiation.

5467

Atomic Energy Project, Univ. of Rochester

HEMOGLOBIN SYNTHESIS IN BONE MARROW AND SPLEEN HOMOGENATES AS AFFECTED BY X-RADIATION. Jonas E. Richmond, Kurt I. Altman, and Kurt Salomon. July 23, 1951. 17p. (UR-179)

Following by 0 to 4 weeks an exposure of rabbits to 800 r of x radiation, spleen and bone marrow homogenates containing α-C^{14}-glycine were prepared. After incubation, hemoglobin, protoporphyrin IX dimethyl ester, and globin were isolated, and the capacity of the homogenates to synthesize hemin and globin was expressed in terms of a new symbol, W, analogous to the W used by Warburg et al. (Biochem. Z. 282, 157(1935)). Bone marrow and spleen homogenates were found to show characteristic patterns of response with respect to hemoglobin synthesis. Variations in the ratios of hemin and globin synthesized indicate that hemin and globin syntheses are dissociated processes, differently affected by radiation.

5468

Atomic Energy Project, Univ. of Rochester

EFFECTS OF IRRADIATION ON EMBRYONIC DEVELOPMENT; I. X-RAYS ON THE 10TH DAY OF GESTATION IN THE RAT. James G. Wilson and John W. Karr. July 30, 1951. 41p. (UR-178)

On the 10th day of gestation pregnant rats were opened surgically and shielded with lead plates in such manner as to permit x irradiation of only 2 to 5 implantation sites. Exposure to 50 r had no appreciable effect on embryonic development. Dosage with 100 r increased slightly the incidence of intrauterine death, reduced the rate of growth, and caused retarded or anomalous development of the eyes. The brain and urinary organs were also occasionally the site of malformations. Irradiation with 200 r caused higher death rate, slower growth rate, and an increased number of malformations. The eyes almost invariably exhibited some defect ranging from anophthalmia to moderate microphthalmia, and the brain and urinary organs consistently showed either retarded or anomalous development. A high percentage of defective feet was recognized after limb buds attained a sufficient degree of differentiation. Reversed asymmetry of the aortic arches and tail in a few instances suggested a tendency toward situs inversus. Closely associated with the high rate of mortality after 200 r was a marked structural alteration in the liver of embryos receiving this dosage. In addition to other changes, hemopoietic activity in the liver was conspicuously reduced or absent after the 13th day, the time at which blood formation in the liver normally begins. Exposure to 400 r always caused embryonic death within 24 hr after exposure. (auth)

5469

Carbide and Carbon Chemicals Co., Y-12 Area

RADIATION EFFECTS ON THE BLOOD. Frances Sachs. July 23, 1951. 11p. (Y-B4-22)

This bibliography contains 51 titles selected from Nuclear Science Abstracts on radiation effects on the blood. The NSA volume number and abstract number for each reference are given.

5470

Atomic Energy Project, Univ. of Rochester
BIOLOGICAL EFFECTS OF EXTERNAL RADIATION [X RAYS AND γ RAYS], p.13-51 of QUARTERLY TECHNICAL REPORT; APRIL 1, 1951, THROUGH JUNE 30, 1951. Henry A. Blair, Director. July 31, 1951. 38p. (UR-174 (p.13-51))

The survival of rats following a single exposure to 625 r of whole-body x irradiation was not significantly altered by diets varying in the relative concentrations of proteins, fats, and carbohydrates. The administration of folic acid (0.1 mg) and citrovorum factor (folinic acid) (200,000) daily to rats before and after exposure to 700 r of whole-body x irradiation failed to change mortality or hematology. Rats given the antibiotic Polymyxin or a combination of Polymyxin and Aureomycin orally following a 700-r total-body irradiation had a much lower incidence of diarrhea than did controls. The combination of antibiotics was the more effective in reducing the diarrhea. No significant differences in weight loss or mortality were noted between the treated and control groups. Immediately after a 450-r whole-body x irradiation, adult dogs were started and continued for 28 days on divided doses of either 50 or 100 mg of Aureomycin/kg/24 hr. The 30-day mortality in the control groups was 60%, in the 50-mg/kg group, 25%, and in the 100-mg/kg group, 20%. No significant difference in leucocyte or platelet count was noted between the groups, but the hematocrit in the control decreased more rapidly. The Octab flocculation test, involving the precipitation of a serum globulin fraction by means of a quaternary ammonium compound was applied to serum of dogs given 450 r of whole-body x irradiation. Erythrocyte sedimentation rates were done concurrently. There was a correlation between the increased sedimentation rate and degree of flocculation following the irradiation. Neither test was of prognostic significance in respect to mortality, but did correlate with the morbidity. The sensitivity to Terramycin and Aureomycin of organisms from 450-r x-irradiated dogs was determined on coliform bacteria isolated from the stools and on bacteria isolated from positive blood cultures. The bacteria show a tendency to develop resistance to both Aureomycin and Terramycin even when recovered from a dog that has received only one of the antibiotics. Bone-marrow studies carried out on four dogs 11 and 13 weeks after single whole-body exposure to an $LD_{50,100}$ dose of x rays are tabulated. The method of aspiration biopsy from sternum, vertebrum, and iliac crest is described.

5471

Atomic Energy Project, Univ. of Calif., Los Angeles
THE EFFECT OF ANOXIA ON THE HEMATOLOGICAL INJURY IN RATS CAUSED BY ROENTGEN IRRADIATION. Leslie R. Bennett, Robert A. Hansen, and Andrew H. Dowdy. Sept. 12, 1951. 18p. (UCLA-156)

Hemograms were made on rats following 500 or 1000 r of whole-body x irradiation administered while the animals were subjected to extreme anoxic anoxia (4% O_2). The results showed that the peripheral blood elements receive a partial degree of protection under these conditions.

5472

Western Reserve Univ. School of Medicine
SOME BIOCHEMICAL EFFECTS OF RADIATION ON LYMPHATIC TISSUE; by Paul S. Lavik and Helen Harrington. July 15, 1951. 30p. (NYO-1626)

The effect of a toxic dose of P^{32} or whole-body x irradiation on the P composition and P^{32} incorporation of thymus, spleen, and normal and regenerating liver has been studied in adult rats. The changes observed in chemical composition have been related to the histological irradiation damage. The radiosensitive lymphatic tissues, thymus and spleen, showed a marked decrease in desoxyribonucleic acid P as a result of irradiation, whereas the P composition of normal and regenerating liver, nonlymphatic tissues, did not change significantly. Radiation caused an inhibition of the P^{32} incorporation into the desoxyribonucleic acid fraction of all tissues but normal liver, which had a very low P^{32} uptake into this fraction in both normal and irradiated rats. Adrenalectomy did not prevent the changes occurring in thymus after irradiation. The relation of the inhibition of desoxyribonucleic acid synthesis to the chemical and histopathological changes which occur is discussed.

5473

Argonne National Lab.
[RADIATION EFFECTS ON TUMORS], p.17-20, 48-57 of QUARTERLY REPORT NOVEMBER, DECEMBER 1950 AND JANUARY 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; by Austin M. Brues, Director. [nd] 14p. (ANL-4571(p.17-20,48-57))

In mice exposed to a single total-body dose of 900 x-radiation spleen shielding did not protect against tumor induction. Tumor incidence one year later was high in comparison with that in mice of the same strain exposed at birth to 400 r. In mice exposed 8 hr per day to γ radiation (0.11 r), the incidence of lymphoid tumors at 20 months after initiation is in agreement with the incidence in controls. The administration of 1300 r total-body x irradiation to mice bearing transplanted lymphosarcomas resulted in greater tumor regression than when the tumor alone was subjected to the same dose. Pretreatment with either 0.01M NaCN, 0.001M NaCN, or 0.01M methylene blue markedly increased the radiosensitivity of tumor pieces exposed to 2000 and 2500 r of radiation. The results indicate that the concentration of the dye is important and strongly suggest that the action of the methylene blue dye was due to zinc ion present.

5474

Argonne National Lab.
[PHYSIOLOGICAL EFFECTS OF X RADIATION], p.21-4, 28-9, 58-9, 94-100, 106-25 of QUARTERLY REPORT NOVEMBER, DECEMBER 1950 AND JANUARY 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, Director. [nd] 25p. (ANL-4571(p.21-4, 28-9, 58-9, 94-100, 106-25))

Preliminary observation of the bone marrow of guinea pigs recovering from anemia induced by chronic total-body γ irradiation (8.8 r, 8 hr/day) revealed a variety of changes. All of the guinea pigs were removed from the exposure field when their red cell counts had dropped to 2.8 million/mm^3. In animals dying within 9 weeks following exposure there was almost complete absence of megakaryocytes in the bone marrow. Where absorptive recovery took place, the marrow cavity was densely packed with cells to the exclusion of the usual fat vacuoles, with a striking absence or near absence of megakaryocytes. Where complete recovery occurred, the bone marrow was comparable with that of nonirradiated controls. Before undertaking experiments involving the exposure of mice to fast neutrons, colorimetric analysis revealed 2.1 ppm of boron in the dry ash of the young mouse and 2.6 to 3.8 ppm in the dry ash of the adult, amounts small enough to be unimportant in the interactions of fast neutrons with the tissues. X irradiation of newborn rats (total doses of 400 to 1000 r delivered at 6, 40, and 80 r/min) induced gross changes that are typical of those that accompany acute irradiation death. Findings of hyperemia and generalized edema suggest that a shock-like condition may contribute to the early death of these animals. Renal hemorrhages and multiple cerebral hemorrhages were found within 1 day after

irradiation. Cultures of Corynebacterium creatinovorans were x-irradiated daily (total 500 to 26,000 r). Results are given of measurements made 8 days later of the endogenous respiration and oxidation of substrates. A correlation between these and similar general inhibitions of substrate oxidation produced on addition of sulfhydryl reagents is discussed. The observed interspecies relation in mammals between the irradiation LD_{50} and mean survival time of decedents from less than LD_{50}'s is explained on the basis that the physiological injury process is represented by a catenary curve and that most mammalian species differ only with respect to a single rate constant. The guinea pig departs from the trend established by the other species investigated and must differ with respect to some additional parameter. Curves of erythrocyte sedimentation in x-rayed dogs, when plotted as log sedimentation distance vs. log time, typically show a hyperbolic form. For about two-thirds of the total distance the log-log plot is linear and can be described in terms of two constants. It is shown that these are affected independently by radiations.

5475

Argonne National Lab.

[RADIATION PROTECTION], p.30-46 of QUARTERLY REPORT NOVEMBER, DECEMBER 1950 AND JANUARY 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, Director. [nd] 17p. (ANL-4571(p.30-46))

Mice, at 28 days after 1100 r total-body x irradiation, showed the following mortality: unprotected mice, 95%; spleen-shielded mice, 50%; and cysteine-pretreated, spleen-shielded, 5%. In experiments to determine the effects of spleen shielding on the survival of mice given repeated doses of x rays (660 or 1025 r) at five monthly intervals, results indicate that only gradually does the accumulated radiation build up to a threshold beyond which survival is impossible. Dosages of 1025 r of irradiation proved fatal to all mice that had not been protected by spleen shielding and estradiol benzoate, but pretreatment with estradiol benzoate plus spleen shielding resulted in 100% survival. Total-body x irradiation (800 or 1000 r) of rats did not increase the basal oxygen consumption nor did it increase the rate of weight loss or the water content of the starving animal. Following injection with a single dose of alpha-estradiol benzoate, mice were given 550 r total-body irradiation 10 days later. Irradiation caused a precipitous drop in cellularity in nontreated controls, while the irradiated, estrogen-treated animals showed a less marked response. More red-blood-cell precursors and lymphocytes survived irradiation in the marrow of the estrogen-treated animals, and changes in the myeloid population of the bone marrow were reflected in the granulocytes of the peripheral blood 3 or 4 days later.

5476

Argonne National Lab.

[CYTOLOGICAL EFFECTS OF RADIATION], p.64-70, 79-88, and 93 of QUARTERLY REPORT NOVEMBER, DECEMBER 1950 AND JANUARY 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, Director. [nd] 18p. (ANL-4571(p.64-70, 79-88, 93))

Studies of the effects of x irradiation on anaerobic diapause grasshopper embryos treated with N_2/CO_2 (95/5%) revealed that, although tissue differentiation was prevented, cells were protected from radiation damage sufficiently to permit cell division. The mechanism of tissue differentiation in the grasshopper embryo has been found to be more susceptible to irradiation damage than the capacity of the cell to divide. This suggests that either the induction mechanism or the capacity of the cell to respond to induction is destroyed. Effects of thermal-neutron irradiation of hemp seed upon growth and sex expression of immediate and subsequent generations are tabulated. The data appear to support the hypothesis that intersex expression in hemp is governed by a dual heredity-environment factor. Both factors, for example, can operate to favor a plant metabolism and growth conducive to the formation of flowers of a sex-type opposite that normally developed. Effects induced by metabolized tritium and presumed to be genetic in nature have been measured in Paramecium aurelia. With increasing radioactivity of the culture fluid (tritium concentrations varying from 1 to 100 mc/ml), increasing death after autogamy was observed but no preautogamous effects were noted, the emitted electrons apparently inducing the biological changes.

5477

National Bureau of Standards

PRINCIPLES OF RADIOLOGICAL PHYSICS; by U. Fano. 236p. (NBS-1002)

This report provides for interim circulation of a manuscript which has been prepared as a chapter of the three volumes on "Radiation Biology" edited by A. Hollaender of the Oak Ridge National Laboratory to be published by the McGraw-Hill Book Company under the auspices of the National Research Council. The report should serve workers in biology and medicine as an introduction to the principles of radiological physics and as a general presentation of available knowledge of the dissipation and penetration of charged particles, neutrons, and electromagnetic radiation in matter and of the biokinetics of radiation action. 82 figures.

5478

Atomic Energy Project, Univ. of Calif., Los Angeles

LATE EFFECTS OF ROENTGEN IRRADIATION; I. STUDIES ON RATS IRRADIATED UNDER ANOXIC ANOXIA. Leslie R. Bennett, Sarah M. Chastain, Jerry S. Flint, Robert A. Hansen, and Alvin E. Lewis. Sept. 7, 1951. 24p. (UCLA-154)

Late effects have been studied to 540 days in rats receiving 600 to 1400 r of whole-body roentgen irradiation under anoxia and surviving the acute post-irradiation period. The findings were marked shortening of life span, high death rate due to pneumonia with a rather specific cellular type in the granuloma, nephrosclerosis and generalized arteriosclerosis, hypertension, blood dyscrasia characterized by thrombocytopenia and anemia (possibly suggesting hypersplenism), cataracts in the animals surviving 10 months or more, general cachexia, and late epilation over head and back. (auth)

5479

CRITICAL INTRODUCTION TO THE STUDY OF THE "HIT" THEORY. PART II. RADIOBIOLOGICAL EFFECTS AND DENSITY OF IONIZATION. Aldo Piergrossi. Radiologia med. 37, 471-88(1951) June. (In Italian)

In this second part of a general outline of the "target" or "hit" theory of the biological action of ionizing radiations, effects of various spacial distributions of ions and the concept of elementary radiosensitive volumes within the living cell are described.

5480

THE EFFECT OF X RADIATION AND RAPID ELECTRONS (4-MEV) ON MITOSIS IN ROOT ENDS OF VICIA FABA. H. L. Heinrich, W. Paul, and G. Schubert. Naturwissenschaften 37, 544-5(1950) Dec.

Roots of Vicia faba were x-radiated with 150, 300, 450, and 600 r, 250 r/min or exposed to rapid electrons of Göttingen's atom reactor, and investigated after 72 hr. Chromosomes suffered increasing shortening, mitoses decreased in number, and number of damages of cells in telo- and anaphases increased with increasingly stronger doses. Rapid electrons were less effective than x rays.

5481
PROTECTIVE PROPERTIES OF SODIUM CYANIDE AND SODIUM NITRIDE AGAINST X RAYS. A. Herve, Z. M. Bacq, and H. Betz. J. chim. phys. 48, 256-7(1951) May-June. (In French)

Injection of 0.1 mg of NaCN immediately prior to irradiation reduces by 50 to 80% the mortality rate of mice totally irradiated by 700 r. Administered after the irradiation, the injection is ineffective. The above treatment does not protect against higher x-ray doses. Similar effects (40 to 50% mortality decrease) are obtained with 0.1-mg doses of Na_3N or 2-mg doses of glutathione; a simultaneous injection of 0.1 mg NaCN and 2 mg glutathione produces additive effects (90 to 95% mortality decrease). While no differences are observed in anatomical radiolesions, the injections tend to prevent such characteristic effects of the irradiation as the disappearance of corticosuprarenal lipids and the accumulation of liver fats.

5482
STUDY OF RECOVERY AFTER IRRADIATION WITH X RAYS. Paul Lamarque. J. chim. phys. 48, 252-5(1951) May-June. (In French)

Hatching-rate curves of repeatedly x-irradiated eggs of the common silkworm (Bombyx mori) point to the existence of a recovery effect; the total dose of two irradiations, separated by a time interval, is larger than the dose of a single irradiation producing the same damaging effect. For a 7-hr interval the optimal recovery is observed when the ratio between the first partial dose and the total dose is equal to 2/3. Recovery processes are ascribed to metabolic activities of the cell.

5483
EFFECT OF HIBERNATION UPON SURVIVAL TIME FOLLOWING WHOLE-BODY IRRADIATION IN THE MARMOT (MARMOTA MONAX). Falconer Smith and Marie M. Grenan. Science 113, 686-8(1951) June 15.

Experiments have been performed to find whether sensitivity to radiation is lower in the hibernator than in the nonhibernator. One group of marmots was allowed to hibernate in a constant-temperature room held at 3.5 to ± 0.5°C and was irradiated 3 weeks after the onset of deep hibernation. A similar group was maintained at room temperature and served as nonhibernating, irradiated controls. Results indicate that a delay in the rate of development of the lethal processes following irradiation accompanies lowered body temperature and reduced metabolic rate in the marmot. The fact that irradiated marmots died in hibernation after only slightly higher doses (one 650 r, one 800 r) than that found lethal for most nonhibernators (550 r) indicates that no great decrease in sensitivity to radiation is attendant upon the change to the poikilothermic state.

5484
CHANGES IN THE TOTAL CIRCULATING EOSINOPHILE COUNT IN CYCLOTRON WORKERS. Campbell Moses and Madeline Platt. Science 113, 676(1951) June 15.

Eosinophile counts were made on three workers who received an indeterminate exposure while sanding the Cu dees of a cyclotron. Two of the three workers demonstrated a marked increase in the number of total circulating eosinophiles over a period of 12 weeks. All counts have since returned to normal and have remained normal for 6 months. It is suggested that the total circulating eosinophile count may be a useful indication of exposure to radiation in individuals employed in x-ray, cyclotron, and other laboratories with radiation hazards.

5485
SOME EARLY NUCLEAR EFFECTS OF IONIZING RADIATION. Shields Warren, Margaret W. Holt, and Sheldon C. Sommers. Proc. Soc. Exptl. Biol. Med. 77, 288-91(1951) June.

Frozen-dried, dry-mounted, Feulgen-stained preparations of tissues of rats and mice intraperitoneally injected with large doses of P^{32} were employed to study early cytologic changes after ionizing radiation. Fine nuclear details are preserved by the freezing-drying method. Lethal radiation effects observed in radiosensitive cells include formation of large intranuclear vacuoles with stretching of nuclear membranes. Nonlethal changes in radioresistant tissues include small intranuclear vacuoles, decreased Feulgen stain of nuclear chromatin and sap, and loss of regular sharp staining of nuclear membranes. Such changes in liver cells may contribute to the acute radiation syndrome.

5486
INCREASE IN THE NUMBER OF LABROCYTES IN THE HEMATOPOIETIC TISSUES OF MICE FOLLOWING X IRRADIATION. Lucie Arvy, Jacques-André Boiffard, and Manfred Gabe. Compt. rend. 232, 1022-4(1951) Mar. 5. (In French)

The important increase in the number of labrocytes (heparinocytes, tissular basophils) found in the medulla of lymphatic ganglia and bone marrow of male white mice following whole-body exposure to 2000 r of x radiation is detailed. The thymic medulla, normally deprived of labrocytes, contains a large number following irradiation. Relation of this phenomenon to the general adaptation syndrome is discussed.

5487
INHIBITION BY TESTOSTERONE OF RADIATION-INDUCED LYMPHOID TUMOR DEVELOPMENT IN INTACT AND CASTRATE MALE MICE. Henry S. Kaplan and Mary B. Brown. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract of this paper appeared in Cancer Research 11, 262(1951) April and is reproduced here in part.

Strain C57 black male mice were distributed as litter mates among four groups of about 50 mice each. Two groups were maintained intact, the other two castrated at 2 months of age. Whole-body irradiation was started 3 to 4 days later; all groups received a total of 675 r in 4 equal fractions at 4-day intervals. One castrated and one intact group received intramuscular injections of testosterone starting on the first day of irradiation, while the other two groups were injected with the aluminum phosphate suspension (placebo) alone. The injection volume was 0.02 cc of either material given twice weekly for 10 weeks. To date, lymphoid tumors have been observed in only 3 of 49 intact, testosterone-treated animals (6%), and in 4 of 50 castrated, testosterone-treated animals (8%), as contrasted with an incidence of 71 and 83% among intact and castrated placebo-treated mice, respectively. Thus, testosterone exerts a striking inhibitory effect on the development of lymphoid tumors in irradiated male mice. Under the conditions of the present experiment, castration of mature male mice did not significantly modify lymphoid tumor incidence.

5488
EFFECT ON LYMPHOID TUMOR INCIDENCE OF CHANGES IN TOTAL DOSE, FRACTIONATION, AND PERIODICITY OF WHOLE-BODY ROENTGEN IRRADIATION. Henry S. Kaplan and Mary B. Brown. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract of this paper appeared in Cancer Research 11, 262(1951) April and is reproduced here in its entirety.

A total of 1733 black mice of both sexes was assigned by randomization of litters to 32 groups, all of which were irradiated at 33 ± 3 days of age. Successive groups received

systematic increments of total dose, administered either as a single treatment or in 2, 4, or 8 equal daily fractions. Equivalent total doses were also given in fractionated treatments at intervals of 4, 8, and 16 days. Lymphoma incidence roughly paralleled total dose, within the range investigated, for either a single exposure or fractionated exposures at daily intervals. Response to equal total doses was not modified by the degree of fractionation. For a given total dose, however, there was a striking increase in incidence when an interval of 4 to 8 days occurred between treatments. Response was no greater than for daily treatments when the interval was increased to 16 days. In contrast, mice exhibited a pronounced ability to recover from the lethal effect of a given total dose with either increasing fractionation or, in particular, the interposition of an increasing interval between treatments. The difference in dose-response characteristics indicates that roentgen radiation operates through different mechanisms in eliciting lethal and leukemogenic responses in mice.

5489

EFFECTS OF IRRADIATION ON EMBRYONIC DEVELOPMENT. James G. Wilson and John W. Karr. Am. J. Anat. 88, No. 1, 1-33(1951) Jan.

On the 10th day of gestation, rats were opened surgically and shielded with lead plates in such manner as to permit direct irradiation of 2 to 5 implantation sites, without exposure of the mother or remaining implantation sites. Exposure to 100 r or more resulted in higher death rate, slower growth rate, and malformations. The organs most affected were eyes, brain, and urinary organs. Exposure to 200 r brought about a structural alteration in the liver. Exposure to 400 r always caused embryonic death within 24 hr after exposure. 29 plates.

5490

STERILIZATION AND INTERSEXUALITY OBTAINED IN CHICKEN EMBRYOS BY X-IRRADIATION. PRELIMINARY REPORT. Berthe Salzgeber. Bull. biol. France, Belg. 84, No. 3, 225-33(1950) July-Sept. (In French)

Localized irradiation of the gonads of chick embryos with 900 to 1200 r in the 24 to 37 somite stage, followed 1 to 2 days later by total irradiation with 300 r, caused some sterilizations in male and female chicks, and 13 of 21 males became intersexes. Irradiation-produced disturbances in hormone production probably caused these abnormalities.

5491

THE EFFECT OF IONIZING RADIATIONS ON THE BROAD BEAN ROOT. PART VIII (continued). L. H. Gray and M. E. Scholes. Brit. J. Radiology 24, 82-92(1951) Feb.; ibid., 176-80(1951) Mar.; ibid., 228-36(1951) Apr.

A detailed study of the effect of x and α radiation on normal root growth of the broad bean, Vicia faba, has been made. The morphological and histological aspects of root growth are discussed and equations are derived correlating root growth with mitotic activity and cell elongation. Morphological observations on root growth as a function of time after irradiation are presented. Data obtained from histological studies of changes in roots exposed to 143 r of x rays are reported. The quantitative aspects of the observed cytological abnormalities are considered with particular regard to cell elongation and the correlation of root growth with mitotic activity. Abstracts of succeeding sections of this paper (Brit. J. Radiology 24, 285-91(1951) May and ibid., 348-52(1951) June) appeared in Nuclear Science Abstracts as NSA 5-4317 and 5-4318, respectively.

5492

THE PROTECTION OF BACTERIA BY PYRUVATE AGAINST RADIATION EFFECTS. T. L. Thompson, Roy B. Mefferd, Jr., and Orville Wyss. J. Bact. 62, 39-43(1951) July.

The presence of pyruvate in a bacterial suspension protects the cells against the lethal and the mutagenic action of ultraviolet and x rays and against the lethal action of hydrogen peroxide. Upon prolonged exposure to ultraviolet, pyruvate solutions become toxic and mutagenic. The addition of the pyruvate after exposure of the cells or its presence in the plating medium does not modify the biological response to the radiations. In organisms lacking in synthetic ability a rich recovery medium may give higher counts of cells injured by ultraviolet. (auth)

5493

RESPONSES OF MITOTIC CELLS IN LIVER AND CARCINOMA TO CONTINUOUS INTERNAL IRRADIATION. Austin M. Brues and Leola Rietz. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-9(1951).

An abstract of this paper appeared in Cancer Research 11, 240(1951) April and is reproduced here in its entirety.

Regenerating rat liver was exposed to internal β irradiation by insertion of glass beads containing Y^{91} or Ce^{144}-Pr^{144}. The distribution of the absorbed energy around these point sources was such that concentric spheres of the tissue received graded dosages varying between zero and amounts sufficient to cause early necrosis. The frequency of mitotic figures was reduced more or less uniformly at a given dosage rate between 8 and 48 hr after insertion, and followed an exponential depression with increasing dosage. Mitotic figures decreased in number in the heavily irradiated areas within 1 hr after insertion of the radioactive source, and virtually disappeared between the 4th and 8th hour. A few residual figures probably represent prolongation of a few mitoses under continuous irradiation. Exposure of the Hall mouse carcinoma under the same conditions resulted in a similar picture. In addition to this, large cells appeared in the region of depressed mitotic activity. It appears probable that this results from continued nuclear and cytoplasmic growth where mitosis is inhibited.

5494

ADRENAL CORTICAL FUNCTION AND LYMPHOID TUMOR INCIDENCE IN IRRADIATED MICE. Henry S. Kaplan, Mary B. Brown, and Sumner N. Marder. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract of this paper appeared in Cancer Research 11, 262-3(1951) April and is reproduced here in part.

Experiment I.—Groups of C57 black mice received local or whole-body irradiation and/or cortisone in various combinations. In the dose administered, whole-body irradiation yielded lymphomas in 41 of 50 mice. When cortisone injections were started simultaneously with irradiation, only 18 of 48 mice developed these tumors, and when cortisone treatment was deferred until 6 weeks after irradiation, only 6 of 23 animals responded. Cortisone alone yielded no tumors. Irradiation over the mediastinum alone, or over the rest of the body with the mediastinum shielded, failed to elicit lymphomas whether or not cortisone was also given. Experiment II.—Two groups of C57 black mice were adrenalectomized and a third subjected to sham operations. Group I received no further treatment; the other adrenalectomized group and the sham-operated group received fractionated whole-body irradiation in four treatments at 2-week intervals. Initial mortality was 20, 67, and 3%, respectively. Lymphoid tumors occurred among 0 of 24, 13 of 20, and 12 of 59 surviving mice, respectively, indicating a significant increase in susceptibility to lymphoma induction among adrenalectomized mice.

5495
THE EFFECT OF IRRADIATION ON AZO DYE NEOPLASIA IN THE RAT LIVER. I. INFLUENCE OF X-RAY AND RADIOGOLD ON THE INCIDENCE OF HEPATOMA AND THE HISTOLOGY OF THE LIVER IN RATS FED DIMETHYLAMINOAZOBENZENE. George Z. Williams, Nelson F. Young, and Jeffries P. Moore. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract of this paper appeared in Cancer Research 11, 289(1951) April and is reproduced here in part.

Sprague-Dawley albino rats were maintained 24 weeks on a synthetic diet containing 0.04% m'-methyl-dimethylaminoazobenzene. Controls fed the basal diet and the azo dye only yielded nine tumors in 38 rats (24%), which survived 6 months or longer. The diet plus m'meDMB and 200 r x rays 3 times weekly for 6 weeks, with a total dose of 3,600 r, resulted in 20 liver tumors in 37 animals (55%); 200 r x rays 3 times per week for only 3 weeks (total of 1,600 r), followed by intrasplenic injection of radioactive gold colloid the fourth week of azo dye diet, caused 10 tumors in 15 rats which survived 6 months or longer (66%). In animals receiving x rays or radiogold, the tumors were larger, occurred earlier, and were multicentric. An unusual cytologic pattern found in many irradiated livers is described. It is concluded that x-ray or Au^{198} (chiefly β) irradiation produces a nonspecific liver-cell damage which increases the incidence of tumors produced by m'-methyl-dimethylaminoazobenzene.

5496
THE EFFECTS OF IRRADIATION ON AZO DYE NEOPLASIA IN THE RAT LIVER. II. CATALASE, ALKALINE PHOSPHATASE, ARGINASE, AND RIBOFLAVIN LEVELS OF THE LIVER FOLLOWING X-RAY AND RADIOGOLD IRRADIATION OF RATS FED DIMETHYLAMINOAZOBENZENE. Nelson F. Young and George Z. Williams. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract of this paper appeared in Cancer Research 11, 291(1951) April and is reproduced here in part.

Sprague-Dawley albino rats were maintained for 24 weeks on a synthetic diet containing 0.04% m'-methyl-dimethylaminoazobenzene. Groups were treated with (a) 250 r (x ray) at 250 kv 3 times weekly to 3,600 r, (b) intrasplenic injections of 2.0 mc or 0.6 mc radioactive gold colloid, and (c) combination of 1,600 r x rays and 2.0 mc of intrasplenic radioactive Au colloid. Alkaline phosphatase ranged between 40 and 100 Bodansky units with diet and dye only. In livers containing tumors but without radiation, it ranged from 75 to 110 (1 at 378), and in the livers containing tumors and subjected to irradiation, levels were from 75 to 180 with 3 above 325. Catalase was low during periods on the riboflavin-deficient diet but rose to normal levels after the animals were returned to stock diet. Irradiation produced no significant changes, and the levels were generally higher in the livers containing tumors. The riboflavin content of the livers was low (10 to 12 μg/g) with basal riboflavin-deficient diet and azo dye, and returned to normal levels of 20 to 30μg on stock diet. The majority of livers of irradiated and tumor-bearing animals contained less riboflavin than normal-appearing livers without irradiation. Irradiation produced no changes in arginase levels. It is concluded that ultimate dietary changes in catalase and riboflavin levels are not influenced by irradiation in the doses applied, and the possible significance of the changes in alkaline phosphatase is discussed.

5497
SUCCESSFUL GROWTH AND SERIAL TRANSPLANTATION OF HUMAN TUMORS IN RATS AND MICE IRRADIATED BY X-RAYS. Helene Wallace Toolan. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract of this paper appeared in Cancer Research 11, 285-6(1951) April and is reproduced here in its entirety.

Cell suspensions prepared from 35 different human invasive neoplasms have been implanted subcutaneously in rats and mice previously subjected to radiation with x rays by a special technic. Twenty-seven gave evidence of active growth histologically like that of the implanted material by the eighth day after implantation. Two have been transplanted for as many as nine generations, and all but three for at least three generations. The neoplasms transplanted include a leiomyosarcoma, a synovioma, several melanomas, an ovarian carcinoma, and a carcinoma of the colon, as well as the more common epidermoid carcinomas. The last have been to date the most prolific. Five carcinomas of mammary origin failed to grow even though female experimental animals were employed.

5498
CHANGES IN THE RADIOSENSITIVITY OF TUMOR FRAGMENTS INDUCED BY PRE-TREATMENT IN VITRO WITH CYSTEINE, METHYLENE BLUE, AND SODIUM CYANIDE. B. Vincent Hall. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29 (1951).

An abstract of this paper appeared in Cancer Research 11, 254(1951) April and is reproduced here in part.

Fresh tumor fragments of a vigorously growing, anaplastic mouse carcinoma were pretreated for 20 min with cysteine, methylene blue, or NaCN solutions, and then irradiated in culture dishes under standard conditions. Solutions of 1.25 mg cysteine per cubic centimeter enabled 58% of the implants to survive 4000 r, whereas none of the control tumor fragments, irradiated in 0.85% NaCl, survived. The growth of nonirradiated tumors was not influenced by cysteine at this concentration. Pretreatment of tumor fragments with 0.01 or 0.001M NaCN or methylene blue, on the other hand, greatly decreased the number of surviving implants. Treatment of nonirradiated tumors with NaCN, or methylene blue solutions of this concentration, had little effect upon the number of subsequent takes, but the more concentrated solutions tended to retard the initial growth of the implants. The decreased tumor radiosensitivity afforded by pretreatment in vitro with cysteine paralleled effects observed in vivo. The other agents, which under certain circumstances were protective in vivo, rendered the tumor more sensitive, suggesting either that they act through different mechanisms or that a summation of injuries is involved.

5499
BIOLOGICAL EFFECTS OF VERY SMALL X-RAY DOSES ADMINISTERED DAILY FOR ONE YEAR. Rudolf Pape. Strahlentherapie 84, No. 2, 245-54(1951). (In German)

It is possible to stimulate blood-forming tissues by means of microdoses. One rat was irradiated for 3 months and two rats for 1 yr with daily doses of 0.25 r. Reactions were noted in the reticulo-endothelium of the spleen and the liver, the resistance of the spleen follicles was found to be increased, and a considerable lymphocytosis was observed. (auth)

5500
EFFECT OF LOCAL ROENTGEN IRRADIATIONS ON THE PERMEABILITY OF CAPILLARIES IN MAN. Anton Neumayr and Bruno Thurnher. Strahlentherapie 84, No. 2, 297-305(1951). (In German)

Increased permeability of the capillaries after x-ray treatments was observed in man, with a threshold effect varying from 3 to 100 r, depending on the individual sensitivity of the capillaries, which also determined the dura-

tion of the morbid state; above the threshold no proportionality between the increase of the protein loss and the dose was observed. These facts prove both the inadequacy of permeability measurements as a way of establishing biological dose units and their utility in the study of the comparative sensitivity of capillary membranes. Twelve-day observations showed that after the healing no changes in the permeability reappeared; therefore, in all probability, the reaction is a one-phase process. (auth)

5501

CONTRIBUTION TO THE PATHOLOGY OF GENERAL X-RAY INJURIES, WITH SPECIAL EMPHASIS ON THE ROLE PLAYED BY HISTAMINE. Willi Hiemsch. Strahlentherapie 84, No. 2, 255-71(1951). (In German)

A test was made of the theory of Reding and Much which ascribes general injurious actions of x rays to protracted anaphylactic toxic shocks. Since this view is essentially related to another rather widely accepted one of the influence of accumulations of histamine in the body, 20 guinea pigs were submitted, after a determination of their histamine-sensitivity threshold, to a fractionated irradiation leading to the lethal dose. Although the intracutaneous histamine-sensitivity increased 3- to 7-fold, parallel experiments in which protective injections of antistine were made did not show any effect of the latter on the lethal dose. It was concluded that the histamine accumulation did not play a decisive part in the general injury of the body produced by x rays. Death was caused by grave lesions of the blood-forming system; no pathologico-anatomical changes pointed to anaphylactic processes. Views ascribing decisive significance to the latter and to general intoxications in x-ray effects should be rejected. (auth)

5502

FURTHER OBSERVATIONS ON INHIBITION OF LYMPHOID TUMOR DEVELOPMENT BY SHIELDING AND PARTIAL-BODY IRRADIATION OF MICE. Henry S. Kaplan. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract appeared in Cancer Research 11, 261-2(1951) April and is reproduced here in part.

Experiment I. —One group of mice was given four doses of 300 r each at 2-week intervals over the upper half of the body only; a second group was given the same dose alternately over the upper and lower halves of the body; a third received four similarly timed treatments of 150 r each over the whole body; the fourth group was treated as the third, except that the mediastinal area was shielded with lead; and a fifth group was kept as an unirradiated control. Lymphoid tumor incidence after 16 months was, respectively, 5, 5, 52, 0, and 0%. Experiment II. —Fractionated alternate irradiation of the upper and lower halves of the body at intervals of 0, 1, 6, and 24 hr yielded lymphoid tumors in 64, 66, 48, and 51% of the respective groups. This response was almost identical with that of mice receiving equivalent whole-body irradiation. Experiment III. —This experiment was intended, in part, to study the effect of preserving ovarian function. The ovaries were transplanted to the muscle of the right hind leg in Groups I and II, and left intact in Group III. During irradiation, mice of Group I were unshielded, while those of Groups II and III had a lead shield placed over the right hind leg. Lymphoma incidence to date has been 42, 10, and 8%, respectively.

5503

EFFECT OF X-RADIATION AND OF RADIOMIMETIC SUBSTANCES ON THE SULFHYDRYL CONTENT OF PLASMA: RELATIONSHIP TO ADRENAL ACTIVITY FOLLOWING STRESS. Bernard Shacter. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract of this paper appeared in Cancer Research 11, 277-8(1951) April and is reproduced here in part.

A study was undertaken on the effects of x radiation and of radiomimetic substances on the sulfhydryl content of rat plasma. In addition, because of the possible relationship between sulfhydryl groups and adrenal activity, the effect of adrenalectomy and of sham operation on plasma sulfhydryl levels was also determined. Exposure of rats to 750 r total body x radiation was followed after several days by a marked decrease in the sulfhydryl content of the plasma. Similar effects were observed following administration of the radiomimetic substances, nitrogen mustard and trisethylene triazine. A decrease in plasma sulfhydryl levels was observed within 24 hr after surgical treatment of rats. Since the plasma sulfhydryl changes occurred concomitantly with the initiation of active tissue regeneration, it is suggested that decreased plasma sulfhydryl levels may be indicative of an increased demand for sulfhydryl groups in tissues during periods of accelerated cellular proliferation, and that the plasma proteins may serve as sources of sulfhydryl groups for tissue requirements.

RADIATION HAZARDS AND PROTECTION

5504

Atomic Energy Project, Univ. of Rochester

ACTIVITIES OF SAMPLES OF PRECIPITATION FOLLOWING NEVADA TESTS, p.90-5 of QUARTERLY TECHNICAL REPORT; JANUARY 1, 1951, THROUGH MARCH 31, 1951. Herbert Mermagen. May 9, 1951. 6p. (UR-164(p.90-5))

The β-γ activity of approximately 100 samples of snow known to have fallen after Feb. 1, 1951, and collected at Rochester, N. Y., and at points 80 miles east, 80 miles west, and 60 miles south were measured. The average activity found was 5.4×10^{-7} μc/cc of show, not considered a health hazard. The apparent half life of the activities was approximately 90 hr, and the approximate energies by Feather analysis about 0.3 and 2 Mev.

5505

Atomic Energy Project, Univ. of Rochester

USE OF COMMERCIALLY AVAILABLE PORTABLE SURVEY METERS FOR EMERGENCY FISSION PRODUCT MONITORING OF WATER SUPPLIES. J. B. Hursh, S. Zizzo, and A. H. Dahl. Aug. 3, 1951. 32p. (UR-180)

As a result of tests using six commercially available survey meters of the thin side-wall, G-M tube, γ- or β-detecting type, it was found that such an instrument had a sensitivity range which made it usable for emergency β monitoring of water contaminated by fission products. A convenient measurement kit has been assembled consisting of an 8-oz metal container for the water to be tested and two calibration standards with the radioactive material distributed on the inner surface of duplicate container lids. These standards are adjusted to give the same meter deflection as produced by mixed fission products in water at concentrations (3.5 μc/liter) judged safe for 10-day consumption, and concentrations (90 μc/liter) judged an acceptable risk for 10-day consumption respectively. (auth)

5506

Carbide and Carbon Chemicals Co., Y-12 Area

LITERATURE SURVEY ON SKIN DECONTAMINATION—UNCLASSIFIED MATERIAL; PART III. F. Sachs. July 5, 1951. 23p. (Y-B4-10)

A total of 169 titles on toxicity of various compounds, skin permeability, radiation effects on the skin, hazards in the use of radioisotopes, carcinogenic substances, decontamination of radioactive areas, protective ointments, and effects of atomic bomb explosions have been selected uncritically.

5507
Atomic Energy Research Establishment, Harwell, Berks (England)
STATISTICAL REVIEW OF HAEMATOLOGICAL TECHNIQUES AND RECORDS. A. C. Chamberlain and F. M. Turner. Mar. 1951. 36p. (AERE-MED/R-708)

The causes and extent of normal variations in the total white cell, lymphocyte, and neutrophil count are considered. Physiological variations are very large, the coefficient of variation in an individual leucocyte count due to this cause over long periods being about 20%. The variations to be expected from acute and chronic radiation are considered in relation to the other variations. Results in the literature and at A.E.R.E. are examined for evidence of discernible effects. It is concluded that white cell counting does not give the measure of protection to an individual implied in the Recommendations of the British X-ray and Radium Protection Committee. There is, however, some evidence of detectable radiation effect on the average count of large groups of workers, even at the low levels maintained at A.E.R.E. It is recommended that white cell counting should be continued on a research rather than a routine basis. (auth)

5508
Kellex Corp.
DEVELOPMENT OF LABORATORY WASTE DISPOSAL UNIT; SUMMARY PROGRESS REPORT; JULY 1951; JOB 24-A. Aug. 6, 1951. 5p. (KLX-1354)

Brief note is made that waste-disposal resins may be dyed with acid-base indicators which will indicate approaching ionic saturation of the resin before the effluent becomes acidic, and thus give warning of conditions under which active, volatile, acidic anions can exist. Both methyl red and phenolphthalein have been used successfully in this application. The use of charcoal impregnated with alkali as an auxiliary adsorbent is being considered since it may aid in Ru adsorption and may also ensure alkalinity in the effluent, thereby preventing the inadvertent liberation of volatile, acidic, active materials. The National Aluminate Corp. mixed bed of fine-mesh resins performed as well as similar mixtures of IR-120 and IRA-400 in removing unsaturated fission products from Jersey City tap water.

5509
X-RADIATION FROM TELEVISION PICTURE TUBES AND OTHER CATHODE-RAY TUBES. (thesis) Sol David Larks. Northwestern University, June, 1951. 89p.

An investigation has been made of the possibility that x rays are emitted by cathode-ray tubes. Emission of x radiation is observed from many of the cathode-ray tubes in current use, and in the medium-voltage range of 20 to 50 kv it is of serious significance, especially in the case of projection television tubes and in the modified forms such as industrial oscillographs and the electron microscope. The implications of what amounts to a new source of irradiation of a significant part of the population are manifold. Account needs to be taken both by industry and by the public of the information available from the fields of biology and genetics. A brief résumé of current thought on the biological effects of low-level radiation absorbed over a long period of time is presented. Some engineering recommendations are made. 77 references.

5510
MEDICAL ASPECTS OF THE ATOMIC BOMB. Albert Rabinowitz. S. African Med. J. 25, 489-93(1951) July 14.

The general nature and development of the acute radiation syndrome are discussed, and the clinical history of each of three forms of it is described in detail. The nature and magnitude of the burn problem (numerically the largest category of atomic bomb injury) and the emergency management of the burn patient are also discussed.

5511
A NEW DESIGN OF RADIUM SAFE EMBODYING STEEL PROTECTION AND WORKING TO VERY STRINGENT PROTECTION STANDARDS. Duncan D. Lindsay and J. McKie. Brit. J. Radiology 24, 207-10(1951) Apr.

The design details are presented of a 2¼-ton steel safe for housing Ra containers. Use is made of racks rather than the conventional drawers for holding the containers. The safe is capable of holding up to 3 g of Ra without exposing a person on the outside to more than the Sievert (Brit. J. Radiology 20, 306(1947)) tolerance dose (0.05 r/wk).

RADIATION SICKNESS

5512
Brookhaven National Lab.
SURVIVAL OF ADRENALECTOMIZED RATS WITH AND WITHOUT REPLACEMENT THERAPY FOLLOWING X-IRRADIATION. Abraham Edelmann. [nd] 13p. (AECU-1599)

The average survival time of rats whole-body irradiated with 650 r of x rays 4 days following adrenalectomy was 4.1 days compared to 7.8 days for adrenalectomized, untreated controls. In contrast, 80% of adrenalectomized, irradiated rats given 3-cc daily doses of adrenal extract and 60% given 5-mg of desoxycorticosterone acetate (DOCA) daily were alive 20 days after irradiation. The length of survival after discontinuance of therapy of the irradiated adrenalectomized rats treated with DOCA or adrenal extract was similar to that of the unirradiated, untreated adrenalectomized rats.

RADIOGRAPHY

5513
Michigan Univ.
A HIGH-RESOLUTION SYSTEM OF AUTORADIOGRAPHY. Henry J. Gomberg. Feb. 1951. 146p. (COO-49)

An autoradiographic technique designed to obtain basic information on structural systems and units, both organic and inorganic, is discussed in detail. The technique, called wet-process autoradiography, combines the use of radioactive tracer atoms and a new form of extremely small, radiation-sensitive crystals, so that the position of radioactive atoms within a structure can be determined to within 1 μ. The development, techniques, and theory of the wet process of autoradiography are described. The precautions necessary to prevent chemical and other undesirable effects from producing images in the absence of radioactivity are discussed, and examples of autoradiographs made by the new system are presented. In addition, the basic mechanism of interaction between radiation, particulate and electromagnetic, and AgBr is considered.

5514
USE OF LIQUID NUCLEAR RESEARCH EMULSION IN TRACK AUTORADIOGRAPHY. Mary Blundell and J. Rotblat. Nature 167, 645-6(1951) Apr. 21. (Letter to the editor)

Techniques in the use of liquid electron-sensitive emulsions in the autoradiography of biological specimens, which have been found useful in reducing sources of error without distorting the specimen, are described.

5515
INTRACELLULAR LOCALIZATION OF COMPOUNDS LABELED WITH TRITIUM, H^3, BY RADIOAUTOGRAPHY. M. L. Eidinoff, P. J. Fitzgerald, E. B. Simmel, and J. E. Knoll. Proc. Soc. Exptl. Biol. Med. 77, 225-9(1951) June.

Radioautographic images were obtained after 2- or 3-weeks exposure of individual yeast cells and paramecia grown in media including Na acetate methyl-labeled with T. Measured radioautographic images of 3-μ diameter of endoplasmic

concentrations of radioactivity in paramecium and individual yeast cells have been delineated. Yeast grown in T-containing media and exposed for a shorter time have shown differential localization of T in polar and peripheral extranuclear areas. Some of these foci showed only one or two grains of reduced silver (each about 0.3 to 0.4μ) in the emulsion. This probably represents the limit of resolution of radioautography with the present emulsions available for biological experiments.

5516
DIRECT TISSUE RADIOAUTOGRAPHY TECHNIQUE APPLIED TO TEETH. Noel D. Martin and E. S. Slater. Science 113, 721-2(1951) June 22.

In an investigation of the permeability of the dentine and enamel to P^{32}-labeled NaH_2PO_4 following the treatment of the teeth by fluorides and other compounds, the authors used the method of Evans (Proc. Soc. Exptl. Biol. Med. 64, 313(1947)), which consists essentially of placing a very fine grain stripping-film emulsion on the surface of the ground tooth section and exposing to the radiation of the absorbed isotope. This emulsion is developed still in contact with the tooth section, and thus a direct view of the penetration is possible. Results indicate that a 2% NaF treatment did not interfere with the penetration of P^{32}, but that NaF followed by $CaCl_2$, resulting in a precipitate of CaF_2 in the cavity, decreased the diffusion to a very great extent. This preliminary work indicates the possible use of the "direct section" autoradiograph and also the effect of a layer of calcium fluoride in decreasing the permeability of the dentine.

RADIOTHERAPY

5517
RADIOCOBALT (Co^{60}) AS A THERAPEUTIC ALTERNATIVE TO RADIUM. C. W. Wilson. Am. J. Roentgenol. Radium Therapy 65, 726-36(1951) May.

The properties of Co^{60} are enumerated and compared with those of Ra. A method of calculating equivalent dosage is given. The application of Co^{60} to teletherapy is discussed with regard to the questions of self-screenage of the source and protection of personnel working with the beam units. Advantages and disadvantages of Co^{60} as compared with Ra are discussed. 7 tables.

5518
DOSAGE OF ROENTGEN RAYS. R. W. Pohl. Naturwissenschaften 38, 147-50(1951) Apr. (In German)

Definitions of dosimetric concepts, as used in radiological practice, are critically examined. The fundamental magnitude is the "specific dose" which is an energy/mass ratio and is directly related to "completely" irradiated objects, or parts of objects, whose thicknesses, therefore, are small compared with the mean range of the radiation employed. A given specific dose implies a "complete" action of the radiation upon the object; it does not just measure the radiation issued from the source. On the other hand, special conditions must be satisfied in measuring the specific dose in the case of very small objects (e.g., Drosophila).

5519
INDIVIDUALIZED INTERSTITIAL IRRADIATION OF CANCER OF THE UTERINE CERVIX USING COBALT 60 IN NEEDLES, INSERTED THROUGH A LUCITE TEMPLATE. Joseph L. Morton, Allan C. Barnes, George W. Callendine, Jr., and Wm. G. Myers. Am. J. Roentgenol. Radium Therapy 65, 737-48(1951) May.

The treatment of 9 cases of cancer of the uterine cervix in late stages is reported. Irradiation was begun by external therapy and continued with newly developed individualized applicators based on the guided-needle principle and using radioactive "cobanic" wire in stainless-steel tubing. The design of the applicator is discussed. Tumor dosage varied between 6000 and 10,000 r in a 7-day treatment period. Minor complications are mentioned.

5520
THE USE OF POSITRON-EMITTING RADIOISOTOPES FOR THE LOCALIZATION OF BRAIN TUMORS. Frank R. Wrenn, Jr., Myron L. Good, and Philip Handler. Science 113, 525-7 (1951) May 4.

In the radioisotope method of localization of brain tumors, a point source of radiation must be accurately located. Two methods of doing this involve (1) use of lead shielding to give directional collimation of γ rays, and (2) use of coincidence counters for oppositely directed positron annihilation quanta. Using recently developed scintillation counters, the authors have found that coincidence counters give a sharper maximum in the curve of counting rate vs. counter position, although the relative number of counts is smaller. Preliminary experiments have been performed on animals using tetrasulfonated Cu phthalocyanine as a source of Cu^{64}.

5521
DOSE DISTRIBUTION MEASUREMENTS WITH THE UNIVERSITY OF ILLINOIS 25-MEV MEDICAL BETATRON. John S. Laughlin, John W. Beattie, James E. Lindsay, and Roger A. Harvey. Am. J. Roentgenol. Radium Therapy 65, 787-99(1951) May.

The conversion of a conventional betatron for medical therapy is described. The roentgen-ray beam has been collimated so as to minimize neutron production and has been shielded effectively in such a manner as to permit accurate and rapid alteration of field size. The output of the betatron is monitored with an ion chamber and is integrated to control the exposure. Techniques for accurate and reproducible dosage measurement with both films and with small ion chambers used with d-c amplifiers have been developed. Depth dose measurements establish a definite though limited dependence of depth dose on field size. Isodose surfaces have been conveniently controlled with a differential filter, and typical distributions are presented which also indicate discontinuities along the geometrical edge of the beam. 15 figures. (auth)

5522
FACTORS INFLUENCING EFFECT OF RADIOACTIVE COLLOIDAL GOLD ON FREE TUMOR CELLS IN PERITONEAL FLUID. Horace Goldie, F. B. Watkins, Carl Powell, and Paul F. Hahn. Proc. Soc. Exptl. Biol. Med. 76, 477-80(1951) Mar.

Experiments using colloidal Au^{198} on free tumor cells growing in the peritoneal fluid of mice show the role of the following factors in production of a radiotherapeutic effect: (1) strain of the tumor; (2) strain of mice; (3) size of the inoculum; (4) interval between inoculation and treatment; (5) route of treatment; (6) dose of radioactivity; (7) pretreatment with inactive gold.

5523
THE DISTRIBUTION OF PARENTAL RADIOACTIVE GOLD COLLOID (Au^{198}) IN THE RAT. Mary Lynn Haigler and George Z. Williams. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-9(1951).

An abstract of this paper appeared in Cancer Research 11, 253(1951) April and is reproduced here in part.

Radiogold sol (Au^{198}) was injected in doses from 10.0 μc to 3 mc in albino rats by intracardiac, intraperitoneal, intrasplenic, intramuscular, and subcutaneous routes. Biological half life was unlimited. Less than 2% of the total injected amount by any route was excreted during the period of measurable activity of the substance. The amount taken up by the liver was as follows: intracardiac, 25%; intrasplenic, 21%; intraperitoneal, 4.1%; intramuscular, 2.3%; subcutaneous, 1% or less. Hyaluronidase increases the amount of Au^{198} circulating in the blood stream after intra-

muscular and subcutaneous injection to 10 and 25%, respectively. Heparin, India ink, and silica were found to have no effect. Dialysis of the radioactive sol through semipermeable cellophane membranes yields 0.16 to 0.37% gold in the dialyzate, which is of the same order as the amount excreted by the kidney. Distribution in the liver as determined by radioautographs is uniform. The sol is phagocytized by the reticulo-endothelial cells of the liver, spleen, lung, kidney, and bone marrow; 90 to 95% is taken out of the blood by the liver and the spleen, very small quantities going to reticular elements elsewhere.

5524

A FLEXIBLE THREAD SOURCE OF 1.25 MILLION-VOLT GAMMA RAYS FOR THERAPY. Joseph L. Morton, George W. Callendine, Jr., and William G. Myers. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract of this paper appeared in Cancer Research 11, 270-71(1951) April and is reproduced here in part.

Cylinders of Co 0.05 by 0.30 cm were exposed to neutrons in the pile until they emitted γ-ray fluxes initially equivalent to that from either 0.21 or 0.42 mg of Ra. The β's from Co^{60} are absorbed by thicknesses of a sheathing filter only one-tenth as great as that required to remove all the β particles emitted by the disintegration products of Ra. The Co^{60} cylinders are slid into nylon tubing and sealed in place by touching the ends of the loaded segment with a hot iron. The excess tubing at each end is warmed and stretched into strong filaments to thread onto surgical needles. The flexible radioactive threads enable the cancer-therapist to sew sources of million-electron-volt γ rays into any radiation-sensitive tumor site accessible to a needle. A typical application has been the transfixion of the portions of iliac lymph glands not removable during a pelvic operation for malignancy, with the active segments of one or more of the radioactive threads. The filamentous extensions are brought together and held in a hemostat and the incision closed to them from both ends. After a week of exposure the radioactive sources are easily withdrawn through the incision without reopening the abdomen.

5525

LES ISOTOPES RADIOACTIFS en MÉDECINE et en BIOLOGIE. M. Tubiana, Paris, Masson et Cie, 1950. 391p.

A large amount of physical, biological, and medical information is summarized. The book is in three parts: (1) a descriptive review of nuclear physics, methods of preparation of radioisotopes, measurement of activity, preparation of radioactive sources, and autoradiography, (2) general bases of biological and clinical applications of isotopes, (3) special topics such as biological actions of radiations, therapeutic uses, and protection from radiation.

TOXICOLOGY STUDIES

5526

Argonne National Lab.
TOXICOLOGY, p.72-106 120-2, 157-62, and 183-91 of DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; QUARTERLY REPORT, AUGUST, SEPTEMBER, OCTOBER, 1950. Austin M. Brues, Director. [nd] 54p. (ANL-4531(p.72-106, 120-2, 157-62, 183-91))

Radium. Clinical attempts to remove Ra from a patient estimated to contain 2 μc by the "deleading" technique of Abu et al. (Ann. Internal Med. 11, 1443-63(1938)), intravenous Na citrate, intramuscular Bi salicylate, and oral $Al(OH)_3$ are reported. A method for determination of Rn in expired air is described. Polonium. Data are presented on survival time, weight changes, and tumor incidence in mice 500 days after Po injection. C^{14}. Metabolism observations to 10 and 20 months after exposure of adult and embryo mice, respectively, to $Na_2C^{14}O_3$ by injection followed by a 10-hr rebreathing of expired air are reported in detail. Tritium. Data on mortality, hemoglobin level, and leucocyte count taken at the end of 20 days during which rats were supplied with drinking water containing 180 to 600 μc of HTO/liter are listed. Beryllium. Aluminon (aurintricarboxylate) is shown to be effective in protecting mice from Be mortality. Uranium. Data on the toxicity of U^{233}, U^{238}, and U^{232} in mice are summarized up to 30 days. Preliminary results of U^{233} metabolism in mice are reported.

5527

Atomic Energy Project, Univ. of Rochester
TOXICITY OF SOME FLUORIDE COMPOUNDS, p.73-7 of QUARTERLY TECHNICAL REPORT; JANUARY 1, 1951, THROUGH MARCH 31, 1951. E. A. Maynard, W. L. Downs, and M. F. LeSher. May 9, 1951. 5p. (UR-164(p.73-7))

Acute toxicity data (24-hr LD_{50} doses) of solutions or suspensions administered intraperitoneally or orally of NaF, KF, NH_4HF_2, CaF_2, KBF_4, BeF_2, and BeO_2F_2 to rats; NaF to dogs; and BeF_2 to hamsters; and ingestion toxicity data of rats fed NaF and BeF_2 are tabulated.

5528

Atomic Energy Project, Univ. of Rochester
THE RADIUM CONTENT OF MILK, p.34-7 of QUARTERLY TECHNICAL REPORT; JANUARY 1, 1951, THROUGH MARCH 31, 1951. Paul D. Shandley. May 9, 1951. 4p. (UR-164(p.34-7))

An investigation is being carried out to measure the Ra content of common foods. The Ra contents of samples of fresh, dried, and commercial powdered milk have been determined by Rn measurement as between 1×10^{-15} and 4×10^{-15} g of Ra/g of dried milk. These values are 10 to 30 times smaller than a value reported by Burkser et al. (Biochem. Z. 211, 323(1929)), 1.8×10^{-12} g of Ra/liter of milk. This latter value becomes 1.4×10^{-14} g of Ra/g dried milk if it is assumed that these investigators analyzed whole milk and that whole milk contains 13% solids.

5529

Atomic Energy Project, Univ. of Rochester
URANIUM [TOXICITY], p.38-54 of QUARTERLY TECHNICAL REPORT; JANUARY 1, 1951, THROUGH MARCH 31, 1951. Henry A. Blair, Director. May 9, 1951. 17p. (UR-164 (p.38-54))

The effects of particle size and purity on the toxic response, as measured by urinary protein, to inhaled UO_2 have been studied by exposing rabbits to suspensions of 0.5-μ mass-median particle diameter. The pH range was kept at 5.0 to 7.5, where uranyl ion and other oxidation products are low in concentration. Comparison with the results of Wilson et al. (J. Ind. Hyg. Toxicol. 30, 319(1948)) indicates that UO_2 itself is nontoxic, the observed chemical toxicity being due to uranyl ion or some complex. The different rates of alveolar deposition and of elimination of insoluble particulates were determined for each of the lobes of the rat lung following inhalation of U_3O_8 or UO_2 of different mass-median particle sizes. The nasal filtration cutoff point in mass-median diameters (MMD) was about 0.7 μ for the rat. Alveolar deposition was calculated to be but 0.9% for U_3O_8 of 2.6 μ MMD based on respired atmospheric concentration of particles of all sizes of this distribution; for UO_2 at MMD 0.45μ, alveolar deposition was 8.3%.

5530

Atomic Energy Project, Univ. of Rochester
BERYLLIUM [TOXICITY], p.55-72 of QUARTERLY TECHNICAL REPORT; JANUARY 1, 1951, THROUGH MARCH 31, 1951. Henry A. Blair, Director. May 9, 1951. 18p. (UR-164(p.55-72))

The analysis of biological materials containing 0.1 μg of Be/g of tissue or less may be accomplished by ashing,

electrolysis in a Hg-cathode cell, extraction of Be acetylacetonate into benzene, back-extraction into HCl, and determination of Be fluorimetrically using morin reagent. The sensitivity is <0.01 μg. Tracer Be^7 was used in this investigation. In rabbits brought to a very mild degree of macrocytic anemia from the daily inhalation of BeF_2 mist, use of α-C^{14}-acetate has shown marked reduction in the rate of incorporation of acetate in hemin and globin compared with the rates in hematologically normal rabbits, but the effect was more pronounced (1.5 times greater) with globin. The reduction is interpreted as indicating an interference by Be in the synthesis of the two moieties of the hemoglobin molecule, suggesting a site of action of Be toxicity in the animal body.

5531

Atomic Energy Project, Univ. of Rochester
BERYLLIUM [TOXICITY], p.104-20 of QUARTERLY TECHNICAL REPORT; APRIL 1, 1951, THROUGH JUNE 30, 1951. Henry A. Blair, Director. July 31, 1951. 17p. (UR-174(p.104-20))

A successful method of continuous production of BeO fumes from metallic Be is described. Specialized small-scale animal-inhalation-exposure equipment was also developed. Preliminary to chronic exposures, a 3-week acute study was made with male albino rabbits at a level of 0.2 mg of Be/m^3. Distribution studies showed reasonable amounts of the material deposited and retained in the lung, small quantities in the femur, and only trace quantities in the kidney. No Be was found in the liver. Hematologic and pathological data indicate no or trace acute damage at this level of concentration. In a pilot study, carrier-free Be^7 was given intravenously to rats. At the same time or 24 hr later, a Ca salt of commercial hexametaphosphate was administered subcutaneously. The urinary excretion of Be^7 was not appreciably modified by this treatment with polyphosphate.

5532

Argonne National Lab.
[TOXICOLOGY STUDIES], p.101, 103-5 of QUARTERLY REPORT NOVEMBER, DECEMBER 1950 AND JANUARY 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, Director. [nd] 4p. (ANL-4571(p.101, 103-5))

A short note compares the human excretion of injected $NaHC^{14}O_3$ with rates observed in smaller animals in order to provide a basis for the computation of permissible human doses of this isotopic compound. Extrapolation to man of information obtained in long-term experiments with rats and mice indicates that an intravenous injection of 20 to 40 mc of $NaHC^{14}O_3$ or the inhalation of a comparable amount of $C^{14}O_2$ would be required to give a 70-kg man a total radiation dose of 1 rem over his entire life span. It was found that aurintricarboxylic acid no effect upon the distribution or excretion of Be that would explain the action of ATA in increasing the survival of Be-poisoned mice, strengthening the hypothesis that the effectiveness of ATA is due to lake formation. When the ratio of ATA to Be is equimolar or less in isolated rat plasma there is no protection against the poisoning effect of Be upon the plasma alkaline phosphatase. Above this ratio an immediate increase in alkaline phosphatase activity is produced. When the molar ratio of ATA to Be is equal to 10, maximum protection of the alkaline phosphatase activity is obtained, the plasma level then becoming equal to that produced by ATA alone.

5533

ON INDUSTRIAL RADIUM POISONINGS. Helmut Roth. Deut. med. Wochschr. 76, 776-7(1951) June 8. (In German)

An analysis of cases of Ra poisoning, as reported by various German writers, shows that, unlike many other industrial poisonings, the pathological effects of Ra present a slow development, prolonged over years, that resembles the latent state of an infection eventually becoming manifest through a general lowering of the body's resistance. It is, therefore, recommended that, besides vigorous ventilation and radiation protection in the establishment, a control of the general state of health of the workers should be organized. (auth)

5534

CORRELATION BETWEEN TOXICITY BY INHALATION AND PHYSICAL PROPERTIES OF BERYLLIUM OXIDE. R. H. Hall, S. Laskin, G. Sprague, and B. H. Brown. Federation Proc. 8, 299(1949) Mar. (See also NSA 4-5131)

The toxicity of inhaled BeO appears to depend on the physical properties of the material, which, in turn, are related to the method of preparation. The processes currently employed for the production of BeO involve calcining a Be salt at high temperatures. Dogs, guinea pigs, rabbits, and rats were exposed 6 hr daily for 12 to 15 days to an atmosphere containing approximately 85 mg/m^3 of BeO aerosol. Even at this relatively high concentration, one grade of BeO appeared to be virtually nontoxic. This material was fired at 1350°C and was composed of unit particles having an arithmetic mean diameter of about 0.7 μ, with aggregates of low porosity (5.2%). A second grade induced definite sign of toxicity. Dogs and rats exposed to an aerosol of BeO produced by calcining beryllium nitrate at 400°C exhibited loss of weight. One of the two dogs showed a significant reduction in blood O tension; eight of 40 rats died.

5535

BERYLLIUM GRANULOMAS OF THE ANTERIOR OCULAR STRUCTURES. A. Benedict Rizzuti. N. Y. State J. Med. 51, 1065-7(1951) Apr.

A case of Be granulomas of the lids and bulbar conjunctiva associated with keratitis is presented because of its rarity and interesting features. These lesions developed from lacerations received from a broken fluorescent lamp.

5536

THE EFFECT OF 2-3 DIMERCAPTO-PROPANOL (BAL) ON EXPERIMENTAL NICKEL CARBONYL POISONING. J. M. Barnes and F. A. Denz. Brit. J. Ind. Med. 8, 117-26 (1951) July.

Rats and rabbits were exposed to the inhalation of nickel carbonyl of known concentrations. The animals either died of acute pulmonary oedema within a few days or recovered to develop pulmonary fibrosis, maximal at three months and gradually resolving. Only 5 to 10 % of the inhaled nickel was found in the lungs. Nickel is rapidly translocated in the body and is not firmly retained by the tissues. In rats, BAL at a dose of 60 to 80 mg/kg given therapeutically had little effect except at one level of nickel carbonyl where significantly fewer rats survived. In rats, BAL given prophylactically had some protective action against the lower doses of nickel carbonyl. In rabbits, BAL given after exposure to nickel carbonyl, reduced the mortality rate and increased the survival time, but these effects were not sufficiently great to be significant with the number of animals employed. (auth)

5537

THE CHARACTER AND DISTRIBUTION OF DISEASE IN AMERICAN INDUSTRIES USING BERYLLIUM COMPOUNDS. Harriet L. Hardy. Proc. Roy. Soc. Med. 44, 257-62(1951) Mar.

A study has been made of the three forms (acute, subacute, and chronic) of Be poisoning. The author considers Be poisoning a systemic disease rather than an exclusively pulmonary response to toxic insult. Apparently Be has a direct toxic effect on certain basic enzyme systems. Pathological study shows that intoxication causes a diffuse cellular infiltration of many tissues, which usually goes on

to partial granulomatous formation and later irreversible fibrous replacement of functioning tissue with resultant clinical illness, great disability in most cases and frequent death.

5538
BLOOD STUDIES IN INTOXICATION EXPERIMENTS WITH URANIUM CHLORIDE. Aldo Masturzo. Folia Med. (Naples) 33, 748-59(1950) Dec. (In Italian)

Weekly blood tests of rabbits intoxicated by repeated doses of uranium chloride revealed notable modifications in the coagulation characteristics of the blood (lengthening of the prothrombin and coagulation times).

5539
ASCORBIC ACID CONTENTS IN BLOOD AND IN URINE DURING EXPERIMENTAL INTOXICATION WITH URANIUM CHLORIDE. Aldo Masturzo. Folia Med. (Naples) 34, 74-83(1951) Feb. (In Italian)

Changes in the ascorbic acid economy of the organism were found in rabbits experimentally intoxicated, for 60 days, with uranium chloride. The lowering of the vitamin C content in blood must be considered as one of the causes of alterations in blood vessels and of coagulation reactions, already observed in such intoxications. The increase in vitamin C content in the urine points to the destruction of reservoirs of that substance and to disorders in the elimination functions, to be correlated with observed lesions in the liver and the kidneys.

TRACER APPLICATIONS

5540
Presbyterian Hospital, Chicago
INTERRELATIONS OF PLASMA AND TISSUE CHOLESTEROL. R. Gordon Gould, Donald J. Campbell, Frank B. Kelly, Jr., C. Bruce Taylor, Jo Anne Hagerman, and Irving Warner. [nd] 1p. (AECU-1456)

The report is reproduced here in its entirety.

Previous experiments on dogs have shown liver to be the source of essentially all the plasma cholesterol, but the origin of cholesterol in tissues and relationships with plasma cholesterol are not clearly established. Many extrahepatic tissues are known to be capable of cholesterol synthesis, but are also able to accept preformed cholesterol that is fed or injected intravenously in emulsified form. In previous studies on the metabolism of isotopic cholesterol, its physicochemical state during passage into tissue cells was not known. The fate of C^{14}-cholesterol after intravenous administration of labeled normal blood lipoproteins was studied. Whole blood containing high and equal specific activities of C^{14} in all cholesterol fractions was obtained by exsanguination of donor dogs given C^{14}-acetate 1 day previously. Other blood constituents had much lower specific activities. Recipient dogs were sacrificed by perfusion under anesthesia at intervals from 4 hr to 14 days after transfusion. Isolation of cholesterol from 15 tissues showed that all except brain gradually acquired labeled cholesterol. The hours required to reach half the specific activity of plasma cholesterol were: liver, spleen, 4 to 6; heart, intestine, 20 to 24; kidney, lung, diaphragm, 45 to 50; aorta, pancreas, 70; and skin, 150 to 200. (auth)

5541
Atomic Energy Project, Univ. of Rochester
TRACER CHEMISTRY, p.78-89 of QUARTERLY TECHNICAL REPORT; JANUARY 1, 1951, THROUGH MARCH 31, 1951. Henry A. Blair, Director. May 9, 1951. 12p. (UR-164 (p.78-89))

The relation between liver cell proteins and plasma proteins has been studied by experiments in which rat and rabbit liver proteins were labeled with lysine-ϵ-C^{14} and then perfused with unlabeled blood. Only a few per cent of the total C^{14} of the labeled liver appears in the circulating blood in 5 or 6 hr. Conversely, when a normal rat liver was perfused with blood containing C^{14}-labeled plasma proteins, only about 2% of the circulating C^{14} of the labeled plasma was found in the liver proteins after 9 hr. The dynamic exchange between plasma proteins and liver proteins is a very slow process in comparison with the rapid formation of plasma proteins from amino acids. In studies on the intermediary metabolism of dl-lysine-ϵ-C^{14}, it has been shown that the phloridzinized rat converts fed lysine-ϵ-C^{14} to urinary glucose in 1 to 3% yield. The locus of C^{14} activity in the glucose is compatible with the known conversion of the carbon chain of lysine to glutamic acid. A measurable amount of C^{14} activity approximating one-tenth that found in the glucose was found present in the urinary ketone bodies.

5542
Oregon State Coll.
ACETATE AND PYRUVATE AS SOURCES OF ASPARTIC ACID IN YEAST. Chih H. Wang, Richard C. Thomas, Robert F. Labbe, Bert E. Christensen, and Vernon H. Cheldelin. [nd] 4p. (AECU-1596)

If, as is often supposed, pyruvate is metabolized largely through dissimilation to an active C_2 unit at the oxidation level of acetate, then carbonyl-C^{14}-labeled pyruvate should furnish aspartic acid with a radioactivity distribution similar to that from carboxyl-labeled acetate. Degradation of aspartic acid isolated from baker's yeast incubated with thus-labeled pyruvate and acetate as sole carbon sources showed all the activity from the acetate substrate to be in the α and β carboxyl groups, whereas aspartic acid from pyruvate contained a high degree of central carbon labeling (42% anaerobically and 62% aerobically). Further degradation of the aspartic acid molecule indicated that the bulk of this activity resided in the amino carbon, which is presumably equivalent to the original carbonyl carbon of pyruvic acid. It would appear that pyruvate may be readily carboxylated directly through the Wood-Werkman or some similar reaction, and that the pyruvate $- C_2$ unit route is not obligatory as a major pathway of metabolism in yeast.

5543
Harvard Medical School
STUDIES ON CARBOHYDRATE METABOLISM IN RAT LIVER SLICES; I. THE EFFECT OF CATIONS IN THE MEDIA. A. Baird Hastings, Ching-Tseng Teng, Frances B. Nesbett, and F. Marott Sinex. [nd] 28p. (AECU-1586)

By using C^{14}-labeled glucose and C^{14}-labeled pyruvate as substrates, the uptake and output of glucose, the formation and breakdown of glycogen, the sources of glycogen, glucose, and CO_2 carbons, the fate of pyruvate carbons in rat liver slices, and the effects of varying K^+ and Na^+ concentrations in the incubation medium on these aspects of carbohydrate metabolism have been investigated. A medium containing 0.110M K^+, 0.020M Mg^{++}, 0.010M Ca^{++}, 0.040M HCO_3^-, and enough Cl^- for electrolytic balance was found to be most favorable for glycogen synthesis from either glucose or pyruvate by rat liver slices in vitro.

5544
THE LOCALISATION OF CEREBRAL TUMOURS WITH RADIOACTIVE DERIVATIVES OF FLUORESCEIN. PHYSICAL LIMITATIONS. E. H. Belcher and H. D. Evans. Brit. J. Radiology 24, 272-9(1951) May.

A theoretical evaluation of the physical limitations to the use of intravenously injected radioactive derivatives of fluorescein for the localization of cerebral tumors is attempted, and experiments are described in which the theoretical findings are confirmed. A brief description is

given of the scintillation counter developed for this work. It is possible to detect lesions concentrating I^{131} with this counter provided that the concentration of activity in the lesion is 10 times that of normal brain and that the size of the lesion is greater than a certain minimum volume depending on its depth. If this depth is 5 cm, the limiting volume is 14 ml; at 8 cm depth it becomes 36 ml. A counting period of 50 sec at each standard position of measurement is adequate, but the use of a ratemeter is recommended. The syntheses of diiodo^{131}fluorescein and of dibromo^{82}-fluorescein are described.

5545

SOME PRELIMINARY CLINICAL OBSERVATIONS ON THE USE OF RADIOACTIVE ISOTOPES FOR THE LOCALISATION OF BRAIN TUMOURS. Jan G. De Winter. Brit. J. Radiology 24, 280-4(1951) May.

A brief account is given of an investigation into the intracranial localization of diiodo^{131}fluorescein carried out at the Royal Cancer Hospital. Thirty-four cases suspected of harboring a brain tumor were investigated. The author states that this method has so far failed to give any definite information as to size and position of cerebral tumors in the great majority of cases. Observations by him on patients indicated that at the time of measurement the effect of vascular activity on counting rates is much greater than that of the activity absorbed in tissue. In only one case was the extent of the tumor traced with a fair degree of accuracy.

5546

RADIOACTIVE IODINATED HUMAN SERUM ALBUMIN AS TRACER AGENT FOR DIAGNOSING AND LOCALIZING INTRACRANIAL LESIONS. Shelley N. Chou, J. Bradley Aust, George E. Moore, and William T. Peyton. Proc. Soc. Exptl. Biol. Med. 77, 193-5(1951) June.

A technique to use I^{131}-radioactive human serum albumin (RIHSA) for the diagnosis and localization of intracranial lesions is described. The uptake of I^{131} split off from RIHSA by the thyroid gland can be prevented by the administration of stable I_2. Advantages of the use of RIHSA are: less expense; 400 to 500 μc will give about the same counting rate as 1 mc of diiodofluorescein currently used; RIHSA stays in tissues longer, permitting repeated counting; and an increase in differential uptake will serve to confirm the presence of a lesion demonstrated in the initial counting.

5547

NEW RESULTS OF EXPERIMENTS WITH THORIUM X ON HUMAN TISSUES. E. Schoen and Heribert Moser. Münch. med. Wochschr. 93, 862-3(1951) Apr. 27. (In German)

While pointing out the possibility of the use of P^{32} in the diagnosis of tumors in certain organs, Cramer (Med. Monatsschr. 5, 118(1951)) excluded the liver and the spleen, because in these organs the radioactivity obtained is the same in healthy and altered tissues. Experiments are reported here showing that the necessary selectivity is observed also in these organs when ThX (Ra^{224}) is used. After an intravenous injection, measurements are made of the rate of the γ-activity decrease. Whereas in a tumorous liver the activity belongs mainly to Ra^{224}, in a nontumorous one it is determined chiefly by Pb^{212} (10.6-hr), a decay product of Ra^{224}.

5548

BIOSYNTHESIS OF RADIOACTIVE ASPARAGINE FROM $C^{14}O_2$. D. G. Wilson, G. Krotkov, and G. B. Reed. Science 113, 695-6(1951) June 15.

Two experiments using the blue lupine, Lupinus angustifolius, and one using young tobacco leaves as synthesizers of radioactive asparagine are reported. Experimental conditions are described in each case. It was found that by extending the time of contact with $C^{14}O_2$ the activity of the asparagine is considerably increased. It might be possible to increase it still further by raising the amounts of C^{14} in the air during the experiment. Since lupine seedlings can be utilized for such a synthesis within 8 days after germination, and since they yield larger amounts of radioactive asparagine than tobacco leaves, their use appears preferable.

5549

RECOVERY AND ESTIMATION OF RADIOISOTOPES FROM BIOLOGIC MATERIALS. II. Rayburn W. Dunn. J. Lab. Clin. Med. 37, 644-52(1951) Apr.

A relatively inexpensive apparatus for the simultaneous electroplating of up to 12 samples of materials is described. Various kinds of cathodes are listed, with their special applications and methods of preparation for use. A general discussion of the nature of solutions of ashed biologic material is included, with a discussion of the use of carriers. A brief outline is presented of procedures for use with Cu, Ag, Zn, Hg, Fe, and Co. (auth)

5550

THE INCORPORATION OF C^{14}-OROTIC ACID INTO NUCLEIC ACID PYRIMIDINES IN VITRO. Lawrence L. Weed and D. Wright Wilson. J. Biol. Chem. 189, 435-42(1951) Mar.

Uridylic and cytidylic acids were separated and recovered quantitatively by paper chromatography. Both were separated from orotic acid by a combination of paper chromatography and ion exchange. Orotic acid labeled in position 2 or 4 with C^{14} was incorporated into the pyrimidines of the nucleic acid in slices of rat liver. Slices of Walker carcinoma 256 from rats incorporated orotic acid into the pyrimidines of the nucleic acid and not into the purines. (auth)

5551

ISOTOPE DERIVATIVE ANALYSIS FOR PROLINE, VALINE, METHIONINE, AND PHENYLALANINE. Sidney F. Velick and Sidney Udenfriend. J. Biol. Chem. 190, 721-31(1951) June.

A modification of the isotope derivative method described previously (Keston et al., J. Am. Chem. Soc. 72, 748(1950)) has been developed for the separation in a pure form, at the microgram level, of the p-iodophenylsulfonyl (pipsyl) derivatives of proline, valine, methionine, and phenylalanine from the derivatives of a complete amino acid mixture. When I^{131}-labeled pipsyl chloride is used to form the derivatives and the corresponding derivatives labeled with S^{35} are added as indicators, these methods may be employed for the positive identification of these amino acids in protein hydrolyzates and for their quantitative determination by the isotope derivative indicator method. A scheme is presented for the isotope derivative analysis of 11 monoamino acids in a single milligram sample of protein.

5552

STUDIES ON THE PLACENTAL TRANSFER OF IRON BY MEANS OF TRACK AUTORADIOGRAPHIC TECHNIC USING Fe^{59}. Dag Campbell and Gunnar Nylander. Acta Physiol. Scand. 23, No. 2-3, 196-204(1951).

The placental transfer of iron was studied in the rat by the method of track autoradiography, using Fe^{59} as tracer. The distributed iron was identified in the fetal tissues very rapidly. The results seem to verify the yolk-sac placenta as playing an important role in the iron transfer mechanism. The visceral yolk-sac epithelium was shown to hold a considerable amount of the injected iron, as compared with the surrounding structures. This concentration rise of the radioactive metal is briefly discussed. (auth)

5553

CALCIUM EXCHANGE; THE MECHANISM OF ADSORPTION BY BONE OF Ca^{45}. Marlene Falkenheim, Elizabeth E. Underwood, and Harold Carpenter Hodge. J. Biol. Chem. 188, 805-16(1951) Feb.

Powdered bone ash adsorbed Ca^{45} from an aqueous solution of $CaCl_2$ without the simultaneous deposition of a proportionate fraction of the total Ca of the solution. This adsorption is adequately explained by assuming that bone Ca exchanged rapidly and reversibly with solution Ca. About one-fifth of the Ca of the bone entered into the exchange reaction. Since the same fraction of the bone P is available for exchange, it is assumed that the exchangeable Ca and P, at least in the rapid exchange reaction, represent atoms from the surfaces of the microcrystals of hydroxylapatite. The Ca exchange follows an exponential curve. P exchange is not exponential but is hyperbolic, both in vitro and in vivo. Fresh bone takes up Ca^{45} in a slower but continuing process that may involve both exchange and recrystallization. 17 references. (auth)

5554

PART PLAYED BY NATURAL RADIOACTIVE ELEMENTS IN BIOLOGICAL PROCESSES. A. A. Drobkov. Uspekhi Sovremennoĭ Biol. 31, No. 1, 82-100(1951). (In Russian)

An introductory outline of investigations on the role played by natural radioactive elements (K, Ra, V, Th, Rb, C^{14}, etc.) in physiological processes in plants and animals is presented, with a special emphasis on works of Russian authors.

CHEMISTRY

5555

Florida State Univ.

ACETOLYSIS RATES OF THE CIS AND TRANS-2-CHLORO- AND 2-BROMOCYCLOHEXYL p-BROMOBENZENESULFONATES. Ernest Grunwald. [nd] 8p. (AECU-1472)

Rate constants measured with the sealed-ampoule technique described in similar studies (Winstein et al., J. Am. Chem. Soc. 70, 821(1948)) show that trans-2-chlorocyclohexyl p-bromobenzenesulfonate undergoes acetolysis only four times as fast as its cis isomer, whereas the trans-2-bromocyclohexyl p-bromobenzenesulfonate reacts 800 times as fast as the corresponding cis-2-bromo compound. This is consistent with the view that the trans-2-bromine atom is furnishing a nucleophilic driving force. Acetolysis rates predicted by calculating the dipole-interaction energies (Kirkwood and Westheimer, J. Chem. Phys. 6, 506, 513 (1938)) make it appear unlikely that mechanisms of the carbonium type are the major reaction paths in the acetolysis of the cis isomers.

5556

Pupin Physics Labs., Columbia Univ.

THE COUPLING OF PHENOL ALCOHOLS WITH BENZENE DIAZONIUM CHLORIDE. E. Marder and I. W. Ruderman. Apr. 6, 1951. 3p. (CUD-62(Rev.); DR-1567)

Although a coupling reaction with a diazonium salt has been used as a qualitative test for unreacted positions ortho or para to the hydroxyl group in phenolic polymers, the general applicability of this reaction to phenol-formaldehyde intermediates has been questioned. It has now been found that 2-hydroxy-α^1-mesitylenol, 4-hydroxy-α^1-mesitylenol, and 2-hydroxy-α^1, α^3-mesitylenediol couple with benzene diazonium chloride in alkaline solution with the liberation of formaldehyde, although these phenol alcohols contain no open positions ortho or para to the phenolic hydroxyl group. These results are the same as those reported by Ziegler and Zigeuner (Monatsh. 79, 42(1948)).

5557

Ames Lab.

THE OXIDATION OF STANNATE(II) ION BY SOME COBALT-(III) COMPLEXES. Richard C. Pinkerton and Frederick R. Duke. Sept. 8, 1951. 17p. (ISC-156)

The oxidation of stannate(II) ion by hexammine- and hydroxypentamminecobalt(III) ions was found to be zero order in the cobalt(III) concentration. Upon standing in strongly basic solution, however, the hydroxypentamminecobalt(III) was found capable of participating in a rate determining reaction. For the hexammine complex, the reaction was found first order in hydroxide concentration and near half order in stannate(II) concentration. It is proposed that stannate(II) ion exists in solution chiefly as a dimer, and that some active form of the monomer is responsible for the reduction. Of a number of anions tested for catalytic effect, cyanide and thiosulfate were found to accelerate the reaction. However, the hexacyanocobaltate(III) ion cannot be reduced by stannate(II) ion. Cyanide is also the only one of the pseudohalides tried which will replace ammonia in the cobalt(III) complexes at a rate appreciable enough to influence the reduction. (auth)

5558

Florida State Univ. and Brookhaven National Lab.

THE REACTION OF NITROUS ACID WITH O-ALKYL-HYDROXYLAMINES. John E. Leffler and Aksel A. Bothner-By. [nd] 8p. (AECU-1592)

Several O-alkylhydroxylamines were treated with nitrous acid with the following results: O-benzylhydroxylamine hydrochloride gave benzaldehyde, N_2, benzyl alcohol, and N_2O; this was the only case in which there seemed to be any formation of carbonyl compounds by way of an intermediate with cationoid oxygen. O-anthranoylhydroxylamine gave the diazonium salt derived from anthranilic acid. The O-n-butyl, O-isobutyl, and O-sec-butyl hydroxylamines gave the corresponding alcohols. In order to obtain information concerning the mechanism of this reaction, N^{15}-enriched HNO_2 was caused to react with ordinary O-n-butyl hydroxylamine. From the relative abundances of the isotopic species of N_2O obtained, the following mechanism was suggested:

$$R-O-N^{14}H_2 + HON^{15}O \rightarrow R-O-N^{14}=N^{15}-OH \;(H^+) \rightarrow ROH + N^{14}\equiv N^{15}=O$$

5559

Atomic Energy Project, Univ. of Rochester

SOME ION-EXCHANGE STUDIES OF THE POLYMERIZATION OF BERYLLIUM; by Isaac Feldman and Jean R. Havill. Aug. 29, 1951. 16p. (UR-181)

The activity coefficient of the Be ion is relatively constant in the Be concentration range 10^{-9}M to 3.6×10^{-4}M and in the ionic strength range 0.1 to 0.4. At this ionic strength, at pH 4.5 and 37°C, the polymerization of Be in perchlorate solution appears to begin when its concentration is raised to about 10^{-5}M. At pH 5.5, Be could not be kept completely in solution, even in tracer concentration, without the addition of complexing agents. (auth)

5560

Los Alamos Scientific Lab.

SOME COMPOUNDS OF TETRAVALENT POLONIUM; by E. Staritzky. Aug. 10, 1951. 9p. (LA-1286)

The following compounds of Po have been prepared and identified by their isomorphism with known compounds of Te and other tetravalent elements: cesium chloropolonate-(IV), Cs_2PoCl_6; rubidium chloropolonate(IV), Rb_2PoCl_6; potassium chloropolonate(IV), K_2PoCl_6; ammonium chloropolonate(IV), $(NH_4)_2PoCl_6$; and tetramethylammonium chloropolonate, $[(CH_3)_4N]_2PoCl_6$. Po^{210} was purified and dissolved in HCl to make a stock solution, and the addition of chlorides (e.g., CsCl) resulted in precipitation of the crystals. The study of these compounds by optical and x-ray-diffraction methods is reported. It was shown that a solution 2.5M in HCl contains Po in the (IV) oxidation state. The ionic species present is presumably $(PoCl_6)^{--}$.

5561
KINETICS OF ISOTOPIC EXCHANGE REACTIONS. G. M. Harris. Trans. Faraday Soc. 47, 716-21(1951) July.

The rate characteristics of isotopic exchange reactions are analyzed in general terms. A discussion is given of the influence of appreciable isotope effect on the kinetics. The nature of the errors involved in the neglect of this factor is considered. (auth)

5562
THE ACTION OF IONIZING RADIATIONS AND OF RADIOMIMETIC SUBSTANCES ON DESOXYRIBONUCLEIC ACID. Part I. THE ACTION OF SOME COMPOUNDS OF THE "MUSTARD" TYPE. J. A. V. Butler and K. A. Smith. J. Chem. Soc., 3411-18(1950) Dec.

In the presence of di-(2-chloroethyl) sulfide ("mustard gas") and of di-(2-chloroethyl)-methylamine (I), desoxyribonucleic acid solutions, buffered at all pH's above 4, are degraded. They lose both their intrinsic viscosity and the additional apparent viscosity which is observed at low rates of flow. It is suggested that this action is related to the nucleotoxic effects of these and similar substances. 2-chloroethyldimethylamine does not degrade the nucleic acid, but the analogous sulfur compound, 2-chloroethyl ethyl sulfide, does. Experiments with partly hydrolyzed (I) indicate that the molecular species which reacts with the nucleic acid is the same as that which combines with sodium thiosulfate. (auth)

5563
ON THE MECHANISM OF THE REACHING OF EQUILIBRIUM DISTRIBUTION OF A MICROCOMPONENT BETWEEN A SOLID CRYSTALLINE PHASE AND A FUSION. V. G. Khlopin, V. R. Klokman, A. N. Murin, and V. D. Nefedov. Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, 127-36(1950) Mar.-Apr. (In Russian)

It is found in a preliminary study that the time required for equilibrium to be reached in a distribution of Ra between a fusion of $BaNO_3$ and its crystals is not affected by stirring. The diffusion coefficient of Ra in $BaNO_3$ crystals at 300° is determined both by direct measurements and by calculating from the foregoing data on the rate of equilibrium establishment. A comparison of the two values of the diffusion coefficient thus determined shows that the equilibrium concentration of Ra in the solid phase is attained not through the action of a diffusion mechanism, but rather through a recrystallization process; the latter is more rapid at 300° than at room temperature because of (1) convection currents, and (2) a more active diffusion of ions into the fusion in the absence of hydration shells. (auth)

5564
THERMOCHEMISTRY AND THE STRUCTURE OF THE ATOM. NOTE 3. FORMATION HEATS OF ANHYDROUS OXALATES OF Mg, Ca, Sr, and Ba. A. F. Kapustinskiĭ and O. Ya. Samoĭlov. Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, 337-43(1950) July-Aug. (In Russian)

In the course of a theoretical study of an interdependence between heat effects and the atomic structure, it was found necessary, owing to the lack of data in the literature, to determine experimentally heats of formation of alkaline-earth oxalates. For a general information on these topics ("thermochemical logarithmics") see Kapustinskiĭ, Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, 568, 582(1948).

ANALYTICAL PROCEDURES

5565
Argonne National Lab.
DETERMINATION OF Na AND P IN BONE BY NEUTRON ACTIVATION ANALYSIS, p.153-5 of DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; QUARTERLY REPORT, AUGUST, SEPTEMBER, OCTOBER, 1950. R. Sato and W. P. Norris. [nd] 3p. (ANL-4531(p.153-5))

The Na and P contents of rat femur ash as determined by neutron activation followed by electrochromatographic separation are compared with chemical analyses.

5566
Brookhaven National Lab.
THE DETERMINATION OF DEUTERIUM IN WATER. L. Friedman and A. P. Irsa. [nd] 11p. (AECU-1593)

An improved method for determining the deuterium content of water samples is described. The method is based on quantitative conversion of hydrogen to ethane, through reaction of the water with zinc diethyl. The ethane is analyzed in a mass spectrometer. The method is applicable above about 0.5 mole % deuterium with an accuracy of about 2% of the per cent composition in the range of routine analyses. (auth)

5567
PHOTOMETRIC DETERMINATION OF SMALL QUANTITIES OF URANIUM WITH THE AID OF POTASSIUM THIOCYANATE. Max Gerhold and Friedrich Hecht. Mikrochemie ver. Mikrochim. Acta 36-37, No. 2, 1100-5(1951). (In German)

U can be determined spectrophotometrically with potassium thiocyanate in strong HCl solution; a blue filter is used. Separation from a number of interfering elements is achieved by extracting with ether. (auth)

5568
MICROANALYTICAL DETERMINATIONS OF GERMANIUM. Friedrich Hecht and Gertrude Bartelmus. Mikrochemie ver. Mikrochim. Acta 36-37, 466-75(1951). (In German)

A macro- and microanalytical study was made of possibilities of gravimetric determinations of Ge as compounds of cinchonine, pyridine, and 8-hydroxyquinoline with germano-12-molybdic acid ($H_8GeMo_{12}O_{42}$) and germano-12-tungstic acid ($H_8GeW_{12}O_{42}$). With the aid of empirically found computation factors, results accurate to within the second decimal place were obtained. (auth)

5569
THE ATOMIC PILE AS A TOOL IN ANALYTICAL CHEMISTRY. E. Picciotto. Rev. cercle sci. univ. libre Bruxelles 1, 20-3(1950) Nov. (In French)

A brief outline is made of the detection and quantitative determination of elements in samples made by placing the latter in the neutron flux of a reactor and observing the effects of the activation.

5570
ORTHO-PHENANTHROLINE AS A REAGENT FOR QUANTITATIVE DETERMINATIONS OF VANADIUM. A. Gottlieb. Mikrochemie ver. Mikrochim. Acta 36-37, 370-8(1951). (In German)

Based on the work of Ephraim (Helv. Chim. Acta 14, 1266(1931)), who used the process V(IV) + Fe(III) – V(V) + Fe(II) for V determination, a colorimetric method has been

developed in which o-phenanthroline HCl is employed as a reagent. No preliminary removal of accompanying elements is required. The sensitivity, which corresponds to concentrations of about 10^{-7}, exceeds that of other procedures for the quantitative determination of V. (auth)

5571

ELECTROLYSIS WITH A RESTORING MERCURY CATHODE. APPLICATIONS FOR THE DETERMINATION OF IMPURITIES IN URANIUM AND CALCIUM SALTS. H. Coriou, J. Guéron, H. Hering, and P. Levèque. J. chim. phys. 48, 55-8(1951) Jan.-Feb. (In French)

With the aid of a continuously restoring Hg cathode traces of reducible metals are removed completely from UO_2SO_4 and $Ca(ClO_4)_2$ solutions. The method, which is particularly convenient for the removal and the determination of Fe and Zn, can also be used in the case of Mn. A preliminary interpretation is attempted of the curves describing the deposition of the metal on the cathode as a function of the time. (auth)

5572

THE DISTRIBUTION OF SEVERAL BIVALENT AND TRIVALENT METALLIC NITRATES BETWEEN WATER AND n-HEXYL ALCOHOL AT 25°. Charles C. Templeton and Lyle K. Daly. J. Am. Chem. Soc. 73, 3989-91(1951) Aug.

The systems of the type water–n-hexyl alcohol–metallic nitrate involving calcium, cobalt(II), magnesium, zinc, and lanthanum nitrates have been studied up to saturation in the liquid-liquid region at 25°. Calcium nitrate is much less extractible into the alcoholic phase than are the other bivalent nitrates. The hydration tendencies of the salts when dissolved in the alcoholic phase are discussed. (auth)

ATOMIC WEIGHTS AND PERIODIC SYSTEMS

5573

ON THE INCORPORATION OF LANTHANIDES AND TRANSURANIC ELEMENTS IN THE PERIODIC SYSTEM OF ELEMENTS. P. W. Schenk. Angew. Chem. 63, 141-2(1951) Mar. 21. (In German)

The two "rare-earth" series, the lanthanides and the actinides, are currently represented as crowded each within one cell of the periodic table. Besides its logical imperfection, such a construction does not reflect (1) very definite chemical analogies, such as that between U and the elements of the 6th group, and (2) a periodicity of certain properties (ion colors) of lanthanides, covering two rows of 7 elements each. These defects are avoided in a new table, where the two short periods, the 2nd and the 3rd (having no subgroups) and the two longer periods, the 4th and 5th (each containing two subgroups), are succeeded by the 6th period embracing 4 subperiods (atomic numbers 55-61, 62-68, 69-78, 79-86) and the 7th period covering the subperiod Fr to Np and the subperiod which begins with Pu.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

5574

Ames Lab.

THE CRYSTAL STRUCTURES OF SOME THORIUM AND URANIUM COMPOUNDS. Norman Charles Baenziger. Oct. 15, 1948. Decl. Sept. 11, 1951. 114p. (AECD-3237; ISC-99)

Complete structure determinations are reported for U_6Mn, U_6Fe, U_6Co, U_6Ni, Th_7Fe_3, Th_7Co_3, Th_7Ni_3, U_2O_5, and U_3O_8. The structures of the first seven of these compounds are considered from the viewpoint of the theory of metals. A new method of determining the intensities of x-ray-diffraction maxima from their photograph record has been developed which involves the radioactive toning of the film. The method appears to be almost as accurate as the ionization-chamber method. The measurement of approximately 10 reflections can be determined per hour with an accuracy of better than 5%.

5575

AN X-RAY MICRO-BEAM TECHNIQUE: I—COLLIMATION. P. B. Hirsch and J. N. Kellar. Proc. Phys. Soc. (London) 64B, 369-74(1951) May.

An x-ray micro-beam technique is described which depends on the use of x-ray beams down to approximately 1 μ diameter, obtained by means of lead glass capillaries. The micro-beam precision camera incorporates collimator holders for aligning the capillaries, and enables simultaneous transmission and back-reflection photographs to be taken. The effect of the divergence of the x-ray beam on the photographs is considered, and a formula is derived for the mean value of the divergence at the specimen. The optimum collimating conditions are discussed in relation to maximum resolution and minimum exposure. The use of totally reflecting glass collimators is considered. An example is given of the application of the micro-beam technique to the study of cold-worked metals. It is found that, using a high-intensity generator, single reflections can be obtained from crystals of diameter of the order of 2 μ in about 10 hr. (auth)

5576

GROWTH AND MANIPULATION OF BARIUM OXIDE CRYSTALS. R. L. Sproull, W. C. Dash, W. W. Tyler, and A. R. Moore. Rev. Sci. Instruments 22, 410-14(1951) June.

A method is described for growing crystals of BaO from the vapor. Seeds of BaO crystals or "pseudoseeds" of MgO crystals are placed in an enclosure of BaO in a vacuum furnace and heated at 1400°C. Single BaO crystals as large as 1×10×10 mm have been grown by this method. Since BaO decomposes very rapidly in the ordinary atmosphere, special techniques for manipulating the crystals are described. These techniques are useful in experiments on the optical, electrical, and electronic properties of BaO. (auth)

5577

CRYSTAL STRUCTURE OF Ti_5Si_3, Ti_5Ge_3, AND Ti_5Sn_3. Paul Pietrokowsky and Pol Duwez. J. Metals (N. Y.) 3, 772-3(1951) Sept.

The crystal structure of the compound Ti_5Ge_3 has been determined from x-ray powder diffraction data. Related silicon and tin compounds have been found to be isomorphous. Unit cell dimensions, axial ratios, and parameters for equivalent atomic positions are given. (auth)

DEUTERIUM AND DEUTERIUM COMPOUNDS

5578

DENSITIES AND MOLAL VOLUMES OF HEAVY WATER BETWEEN 20° and 100°C. R. Schrader and K. Wirtz. Z. Naturforsch. 6a, 220-1(1951) Apr. (Note; in German)

By use of a pyknometric method described elsewhere (Wirtz, Naturwissenschaften 30, 330(1942), measurements were made of densities and molal volumes of D_2O in the temperature range 20 to 100°C. The results are presented in tables with data of other authors.

5579

THE REACTION OF METHANE AND DEUTERIUM ON EVAPORATED NICKEL CATALYSTS. C. Kemball. Proc. Roy. Soc. (London) 207A, 539-54(1951) July 23.

The production of all four deuteromethanes from the reaction of methane and deuterium on evaporated nickel films in the temperature range 206 to 255°C was followed by means of a mass spectrometer. The compound CD_4 was the most abundant product in the initial reaction, and there was other evidence that the adsorption of deuterium was stronger

than the adsorption of methane. The surface areas of the films were found by the adsorption of deuterium at 0°C which was instantaneous and the films were shown by electron diffraction to be unorientated. An activation energy of about 11 kcal/mole was required for the adsorption of methane.

Two types of reaction were distinguished: the first produced CH_3D with an energy of activation of 24 kcal/mole and the initial rate varied as $P_{CH_4}P_{D_2}^{-\frac{1}{2}}$; the second having an energy of activation of 32 kcal/mole, a greater entropy of activation and a rate dependent on $P_{CH_4}P_{D_2}^{-1}$, gave the other three compounds CH_2D_2, CHD_3, and CD_4. Mechanisms for these reactions are formulated. The equilibrium constants for the interconversion of the five methanes were determined at 466°C and compared with calculated values. (auth)

FLUORINE AND FLUORINE COMPOUNDS

5580

ATOM-VIBRATION FREQUENCY IN THE FLUORINE MOLECULE, THERMODYNAMIC FUNCTIONS OF FLUORINE, AND EQUILIBRIUM CONSTANT OF THE $F_2 \rightleftharpoons 2F$ REACTION IN THE TEMPERATURE RANGE 298.1 to 5000°K. K. V. Butkov and R. B. Rozenbaum. Zhur. Fiz. Khim. 24, 706-13(1950) June. (In Russian)

Using the latest values of physical constants, and taking into account the nonlinear character of intramolecular vibrations and the influence of the centrifugal force on the size of the molecule, a calculation is made, for the temperature interval 298.1 to 5000°K, of the following characteristics of F: (1) frequency of intramolecular vibrations; (2) specific heat, entropy, and reduced enthalpy of molecular fluorine considered as an ideal gas; (3) reduced isobaric thermodynamic potentials for molecular and atomic F; and (4) equilibrium constant of the process $F_2 \rightleftharpoons 2F$.

5581

PYROLYSIS OF PERFLUORO-n-PENTANE. Gail C. Rogers and George H. Cady. J. Am. Chem. Soc. 73, 3523-4(1951) July (Notes)

Preliminary report is made of a study of the pyrolysis of a single saturated fluorocarbon, perfluoropentane, C_5F_{12}. The experimental procedure is outlined; results of runs at 6 temperatures from 840 to 1325°C are tabulated; and speculations are made as to the mechanism of dissociation.

5582

ORGANIC FLUORIDES. PART VII. CO-ORDINATION COMPOUNDS OF FLUOROACETYLACETONES. R. N. Haszeldine, W. K. R. Musgrave, F. Smith, and L. M. Turton. J. Chem. Soc., 609-12(1951) Feb.

Mono-, tri-, and hexafluoro derivatives of acetylacetone have been prepared by a Claisen type of condensation. Only the hexafluoro derivative, where two CH_3 groups have been replaced by CF_3 groups, shows properties which differ greatly from those of the parent acetylacetone. Certain coordination compounds have been made, and their absorption spectra have been determined. The uranous complexes with trifluoroacetylacetone and hexafluoroacetylacetone can be sublimed in vacuum without decomposition. (auth)

5583

THE REACTIONS OF FLUOROCARBON RADICALS. PART IV. THE SYNTHESIS OF 3:3:3-TRIFLUOROPROPYNE. R. N. Haszeldine. J. Chem. Soc., 588-91(1951) Feb.

Interaction of trifluoroiodomethane and acetylene gives mainly 3,3,3-trifluoro-1-iodopropene, dehydroiodination of which yields 3,3,3-trifluoropropyne, the first of a new class of compound with perfluoroalkyl groups adjacent to an acetylenic residue. The hydrogen atom is acidic, and Cu, Ag, and Hg trifluoromethylacetylides have been prepared. The last compound is a stable, low-melting solid. Oxidation of the fluoroalkyne affords trifluoroacetic acid, and hydrogenation and chlorination give 1,1,1-trifluoropropane and 1,1,2,2-tetrachloro-3,3,3-trifluoropropane, respectively. (auth)

5584

SYNTHESIS OF FLUOROCARBONS, PERFLUOROALKYL IODIDES, BROMIDES AND CHLORIDES, AND PERFLUOROALKYL GRIGNARD REAGENTS. R. N. Haszeldine. Nature 167, 139-40(1951) Jan. 27.

When tetrafluorodiiodoethane is heated with tetrafluoroethylene, polymerization occurs and the compound $I(CF_2CF_2)_2I$ is readily isolated. This compound is also formed when tetrafluoroethylene and iodine are heated under pressure. In both cases members of the series $I(CF_2CF_2)_nI$ are formed. By the replacement of one I atom by F, the compounds $I(CF_2CF_2)_nI$ have been converted into fluoroiodides, $CF_3(CF_2)_nI$, by treatment with IF_5, SbF_5, or F_2 diluted with N_2. Photochemical or thermal bromination or chlorination of the compounds $I(CF_2CF_2)_nI$ yields $Br(CF_2CF_2)_nBr$, or $Cl(CF_2CF_2)_nCl$, and small amounts of $Br(CF_2CF_2)_nI$ and $Cl(CF_2CF_2)_nI$. The last two mentioned series, where n = 1, have been synthesized by the addition of IBr and ICl to tetrafluoroethylene. Representative compounds of $Br(CF_2CF_2)_nBr$ have been converted into $CF_3(CF_2)_{2n-1}Br$ by treatment with BrF_3. The perfluoroalkyl monobromides, which are obtained from $CF_3(CF_2)_nI$ by treatment with Br, give fluorocarbons. The conversion of $Cl(CF_2CF_2)_nCl$ into $CF_3(CF_2)_{2n-1}Cl$ and $CF_3(CF_2)_{2n-1}CF_3$ is achieved by reaction with F_2 diluted with N_2, or with ClF_3 or SbF_5 under pressure.

5585

SOLUBILITY OF FLUORINE GAS IN VARIOUS FLUOROCARBONS AND CONCENTRATED ACIDS. W. B. Burford III, C. E. Weber, H. C. Anderson, and M. B. Rogers. Chap. 11 in PREPARATION, PROPERTIES, AND TECHNOLOGY OF FLUORINE AND ORGANIC FLUORO COMPOUNDS. Charles Slesser and Stuart R. Schram, eds.; NNES Div. VII, Vol. 1.

Measurements have been made of the solubility of fluorine in perfluoro oil, KF.HF melts, SbF_5, H_3PO_4, and H_2SO_4. Determinations were made at partial pressures of 3 atm and, where possible, 20 atm. Two techniques were employed: sampling of the liquid after exposure, followed by iodometric determination of fluorine; and, alternatively, observation of the pressure drop in a closed system.

All five liquids were found to be fairly inert under low pressure, but reliable data could be obtained only for the first three since the reaction with the container was large in the case of the two acids. In the case of the perfluoro oil there was a slow reaction resulting in the liberation of small amounts of HF. The source of this reaction was not determined, although it appeared to be partly due to unsubstituted hydrogen in the oil. The oil was unstable to fluorine under high pressure, but the KF.HF melts and SbF_5 were stable under all pressures investigated.

The solubilities were all low, in the range of 0.1 to 0.4 ml of gas (S.T.P.) per gram of liquid at a partial pressure of 3 atm and up to 2.3 ml/g at 20 atm. The behavior was similar to that of inert gases in liquids and there was no evidence of abnormal solubility due to compound formation. (auth)

5586

EFFECT OF HYDROGEN CONTENT ON STABILITY OF PERFLUORO OILS. C. E. Weber, W. B. Burford III, J. M. Hamilton, Jr., H. C. Anderson, M. B. Rogers, and I. Litant. Chap. 39 in PREPARATION, PROPERTIES, AND TECHNOLOGY OF FLUORINE AND ORGANIC FLUORO COMPOUNDS. Charles Slesser and Stuart R. Schram, eds.; NNES Div. VII, Vol. 1.

A method has been developed that leads to stabilization of perfluoro oils toward fluorine gas. It consists essentially

in treating the oil with fluorine at slowly increasing temperatures up to the boiling point of the liquid. Such treated oils show a marked stability toward elemental fluorine and will react only at elevated temperatures in the neighborhood of 250 to 300°C. Yields are good, averaging 88% or better.

The removal of hydrogen accompanies the process of stabilization and may be the basis of this phenomenon. Untreated oils contained, in general, approximately 0.02% hydrogen, whereas some treated materials were found to contain 0.0005% or less. There appeared to be a rough correlation between the amount of hydrogen present and the amount of degradation or destruction of oil that accompanied stabilization, suggesting that the instability was at least partly connected with the presence of hydrogen in the molecule.

A test method known as the "ignition-temperature test" is described; it was found useful for the determination of hydrogen in the range 0.3 to 0.05 wt.%. The effect of variables and impurities on this test was studied. Chemical analysis for hydrogen was found to be difficult, and a description is given of other methods including neutron and infrared absorption. A standardization program employing these methods is described.

LABORATORIES AND EQUIPMENT

5587

Atomic Energy Research Establishment, Harwell, Berks (England)

AN AUTOMATIC RADIOACTIVE LIQUID SAMPLE SEPARATOR. A. E. Bennett. Apr. 11, 1951. 38p. (AERE-EL/R-688)

The process of ion-exchange separation of fission products by elution is a relatively slow one, and in any detailed study of this separation process considerable time and effort must be spent in long continuous periods of counting. To overcome this difficulty a completely automatic equipment has been designed which will distribute the various separated elements into different containers and give a detailed record of the effluent activity. The apparatus and its sequence of operations are described in detail. 14 figures.

5588

Carbide and Carbon Chemicals Div., UCC, K-25

CONSTANT PRESSURE APPARATUS FOR STUDYING REACTION RATES. W. Davis, Jr., and F. D. Rosen. Mar. 27, 1950. Decl. Sept. 10, 1951. 10p. (AECD-3234; K-581)

An automatic constant pressure system has been designed and constructed on the basis of fluid displacement in a sylphon bellows system. Booth-Cromer gages, operated in conjunction with appropriate self-balancing relays, have been used to maintain constancy of pressure. The apparatus has been tested at 25 and 60°C with air or fluorine as the confined gas, at total pressures of ⅓ to ½ atm, and for periods as long as 30 days. Reaction or evacuation rates of 1 to 16,000 cc atm per day gave pressures that have been found to remain constant within about 1%. (auth)

5589

STORAGE CABINET FOR RADIO ASSAY PREPARATIONS. O. Kantorowicz. J. Sci. Instruments 28, 189(1951) June. (Laboratory and workshop notes).

Preparations containing C^{14} are deposited on molded plastic dishes (0.8-in. diam nominal, 0.125 in. thick) with a cavity (0.063 in. deep) of either 1 or 2 cm^2 area. Storage cabinets were designed in which the dishes up to 25 are placed into recesses of 0.8-in. diam drilled 0.063 in. deep at a center distance of 1 in. into trays made from 0.25-in. thick Perspex plate. Centrally between every four such recesses is drilled a somewhat deeper recess, 16 in all, of the same diameter, and as these deeper recesses overlap the first-mentioned ones it is easy to place or to remove dishes by means of forceps.

5590

A SET OF PARTS FOR THE REMOTE HANDLING OF RADIOACTIVE SUBSTANCES. A. B. Ritchie and W. T. Spragg. J. Sci. Instruments 28, 214(1951) July.

A set of parts capable of being used for a wide variety of radiochemical manipulations is described. The set consists of tong rods, detachable tongjaws, a railway system for conveying jaws and reagents behind shielding, and spherical ball joints. The set permits flexible manipulations using distance, Perspex or lead shielding. (auth)

RADIATION CHEMISTRY

5591

POLYMERIZATION AS A GUIDE TO TRACK DISTRIBUTION. F. S. Dainton. J. chim. phys. 48, 182-3(1951) Mar.-Apr.

Vinyl compounds in dilute aqueous solutions are readily polymerized by the indirect action of ionizing radiations which are absorbed by water with the formation of H and OH radicals. Since the kinetics of this polymerization in discrete tracks of ionizing rays is different from that of polymerizations in cases when H and OH are generated throughout the whole volume of the system (e.g., by photochemical processes), it follows that these differences can be used for the determination of the relative, and possibly also the absolute, distances between the tracks as a function of doses of ionizing radiations.

5592

PROTECTION EFFECTS IN SZILARD-CHALMERS REACTIONS. E. Broda and H. Mueller. J. chim. phys. 48, 206(1951) Mar.-Apr. (In French)

The presence of secondary oxidations which reduce the yield of radioactive As(III) obtained from As(V) by the Szilard effect, can be illustrated by submitting the substance to a γ irradiation before, or simultaneously with, the neutron irradiation; the yield is found to be reduced, owing, probably, to the oxidizing action of the products of ionization of water. A protection against such secondary oxidations is obtained by adding very small quantities (10^{-7} mole/liter) of inactive As(III) to the original substance.

5593

ROLE OF OXYGEN-CONTAINING RADICALS IN OXIDATIONS AND REDUCTIONS PRODUCED BY IONIZING RADIATIONS. I. STUDY OF THE CEROUS-CERIC SYSTEM. M. Haïssinsky, M. Lefort, and H. Le Bail. J. chim. phys. 48, 208-12(1951) Mar.-Apr. (In French)

X and α rays reduce ceric salts in acid media and oxidize cerous salts in K_2CO_3 solutions, no oxidations being observed in former cases or any reductions in the latter ones. In the reducing process the efficiency of x rays is higher than that of α radiations. The efficiency of the reduction is lowered by the presence of H_2. All these facts are explained by assuming that not only oxidations are produced by OH radicals, but that reductions also are essentially traceable to them and, in a general way, to oxygen-containing radicals, while H atoms play a subsidiary part only. This difference in the behavior of the two kinds of ionization products is of a purely chemical nature, proceeding from such features as the ready recombination of H atoms, accompanied by a loss of reducing properties, as contrasted with the vast choice of possible OH reactions, some of them being of a chain nature and resulting in the formation of various oxidizing and reducing compounds and radicals.

5594

THE SZILARD-CHALMERS EFFECT IN ARSENIC AND ARSENOUS ACIDS. H. Müller and E. Broda. Monatsh. 82, 48-52(1951) Feb. 15. (In German)

A determination was made of the distribution of radioarsenic between the two oxidation states of As after irradiation with neutrons of arsenites and arsenates in the solid state and in solutions. In solutions of either salt the distribution is independent from the concentration, the pH value, and the temperature. On the other hand, a higher proportion of As*(V) is obtained when either salt is activated in the solid state with fast neutrons instead of with slow ones. It is concluded that, unlike effects observed in the permanganation, the valence of As* is determined during the primary reaction, i.e., during the explosion of the ion following the capture of a neutron. (auth)

RADIATION EFFECTS

5595

Argonne National Lab.

THE EFFECT OF X IRRADIATION ON THE ABSORPTION SPECTRA OF ADENOSINE TRIPHOSPHATE, PYRIDINE NUCLEOTIDE, AND NUCLEIC ACIDS, p.143-52 of DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; QUARTERLY REPORT, AUGUST, SEPTEMBER, OCTOBER, 1950. E. S. G. Barron and Veronica Bonzell. [nd] 10p. (ANL-4531 (p.143-52))

Depression of the maximum height of the absorption spectra of dilute solutions of adenosine triphosphoric acid, adenylic acid, diphosphopyridine nucleotide, Na desoxyribonucleate, and Na ribonucleate by x irradiation in the presence of O_2 indicates that x irradiation alters the absorption spectrum of purines and pyrimidines by oxidation of the chromophore groups.

5596

PHYSICOCHEMICAL PHENOMENA ACCOMPANYING NUCLEAR REACTIONS IN FINELY PULVERIZED SOLIDS IRRADIATED WITH NEUTRONS. Pierre Jordan. Helv. Chim. Acta 34, 715-22(1951) Mar. 15. (In French)

A study of physicochemical effects of irradiations of fine powders with fast neutrons showed that a notable fraction of newly formed radioactive atoms concentrate on the surface of the grains and can be extracted by solvents. Thus, when moist powders are irradiated, some of the products, viz., those formed in (n,p) and (n,α) reactions pass into the liquid phase, while those generated in (n,γ) and (n,2n) processes react chemically with the parent substances and remain within the grains.

5597

SOME EFFECTS OF TEMPERATURE, PHASE AND NATURE OF CHEMICAL SPECIES ON HALOGEN ATOM REACTIONS INITIATED BY RADIATIVE NEUTRON CAPTURE AND BY ISOMERIC TRANSITION. S. Goldhaber, R. S. H. Chiang, and J. E. Willard. J. Am. Chem. Soc. 73, 2271-5(1951) May.

The organic yield of Br activated by either radiative neutron capture or isomeric transition in liquid CCl_3Br appears to increase slightly when the temperature is lowered from room temperature to the melting point (−5°C), to increase abruptly with change from the liquid to the solid phase at the melting point, and to increase slowly with cooling of the solid phase to −80°C. The increase in the organic yield is qualitatively parallel to the increase in density of the medium. The distribution of the organic products of the (n,γ) reaction is about 45% CCl_3Br, 35% CCl_2Br_2, and 20% higher boiling compounds at both 25 and −80°C. Increases in the organic yield with decrease in temperature and/or change of phase occur for the (n,γ) reaction on Br in CCl_2Br_2, in CBr_4, and in solutions of Br_2 in CCl_4; and for the (n,γ) reaction on Cl in CCl_4 and in CCl_2Br_2. Low concentrations of Br_2 present in CCl_3Br during neutron irradiation decrease the organic yield of Br^{80} while low concentrations of α,β-dibromoethylene increase the yield. The organic yield of I activated by the (n,γ) reaction in dilute solutions of I_2 in saturated hydrocarbons averages about 35% while that of dilute solutions of ethyl iodide in the same solvents is about 50%. (auth)

5598

FORMATION OF HYDROXYLAMINE FROM AMINO-COMPOUNDS IN AQUEOUS SOLUTION BY IRRADIATION WITH X-RAYS. George Scholes and Joseph Weiss. Nature 167, 693(1951) Apr. 28. (Letter to the editor)

It has been established that x irradiation of aqueous solutions of the bases adenine, guanine, and cytosine and of other amino compounds gives rise to some hydroxylamine. Irradiation of ammonia did not yield hydroxylamine.

5599

THE SZILARD-CHALMERS EFFECT WITH SLOW AND FAST NEUTRONS. PART I. THE SZILARD-CHALMERS EFFECT (THE CASE OF THE PERMANGANATE ION). Werner Rieder. Acta Phys. Aust. 4, 290-303(1950) Dec. (In German)

The action of neutrons on MnO_4^- ions is examined in a study of the Szilard-Chalmers effect. While the main product is a precipitate of Mn^*O_2, the filtrate also shows some activity whose intensity depends on the pH of the original solution. Libby (J. Am. Chem. Soc. 62, 1930(1940)) interpreted these facts by assuming that both Mn^*O_2 and the substance responsible for the activity of the filtrate (probably $Mn^*O_4^-$) are formed in secondary chemical reactions after the molecule, shattered by the nuclear "explosion" of its Mn atom, had slowed down through intermolecular collisions. These ideas are confirmed in experiments described in which both thermal and fast neutrons were used. The activity of the filtrate is found to be independent of the neutron energy; thus, the effect of the higher kinetic energy of fast neutrons is not felt in the secondary chemical processes. Similar results were obtained with $KMnO_4$ crystals irradiated and dissolved in water.

5600

CHEMICAL CHANGES PRODUCED IN WATER BY IONIZING RADIATIONS OBTAINED IN A PILE FROM THE PROCESS B(n,α)Li. Marc Lefort and Jacques Pucheault. J. chim. phys. 48, 108-9(1951) Jan.-Feb. (In French)

Formation of H_2O_2 during irradiations of water was studied using α rays from the reaction B(n,α)Li which was produced in a nuclear reactor. After introducing a correction for the decomposition of H_2O_2 through the action of γ rays present in the reactor, differences were found between the shape of the curve giving the quantity of H_2O_2 formed as a function of the energy absorbed, and the shape of a similar curve obtained with α rays from Rn. The difference is due to the decomposition of H_2O_2 by boric acid.

RARE EARTHS AND RARE EARTH COMPOUNDS

5601

Ames Lab.

CONDUCTANCES, TRANSFERENCE NUMBERS, AND ACTIVITY COEFFICIENTS OF CHLORIDES OF SOME HIGH ATOMIC NUMBER RARE EARTHS IN AQUEOUS SOLUTION. F. H. Spedding and James Malcolm Wright. Mar. 1951. 98p. (ISC-143)

The conductances, transference numbers, and activity coefficients of $LaCl_3$, $SmCl_3$, $EuCl_3$, and $YbCl_3$ were determined in order to test the present theories of electrolytic solutions as well as to make available accurate data on these properties for rare earth chlorides. A simply constructed transference cell and an electronically controlled constant-current apparatus are described. The infinite dilution values for the equivalent conductances, the cation conductances, and the cation transference numbers were calculated. Agreement

with theory and anomalous behavior are discussed in detail. 17 tables. 15 figures.

5602

OBSERVATIONS ON THE RARE EARTHS. LX. THE ULTRAVIOLET ABSORPTION SPECTRUM OF THE GADOLINIUM ION IN AQUEOUS SOLUTIONS. Therald Moeller and Frank A. J. Moss. J. Am. Chem. Soc. 73, 3149-51(1951) July.

The ultraviolet absorption spectrum of the gadolinium ion has been reinvestigated for both aqueous chloride and perchlorate solutions under conditions of high resolution. The spectrum is characterized by eighteen absorption peaks and two definite inflections in the wavelength region 2400 to 3150 A. The major and most complex absorption bands lie in the range 2720 to 2765 A, where greater resolution than previously reported has been obtained. Absorption is essentially the same for both chloride and perchlorate solutions. For both, absorptions at 2729, 2741-2, and 2756 A are in accord with Beer's law to concentrations above 0.25M. (auth)

5603

LANTHANON PURIFICATIONS BY THE USE OF HEXA-ANTIPYRINE LANTHANON IODIDES. J. K. Marsh. J. Chem. Soc., 1337-9(1951) May.

Fractional crystallization of heavy hexa-antipyrine lanthanon iodide $[Ln(C_{11}H_{12}ON_2)_6]I_3$ yields efficiently pure Lu material. The separation of Tm and Lu is good, and that of Tm from Er and Y very satisfactory, though more difficult. Y separates very slowly from Er, and, uniquely, on the Tm side. Y separates well from Ho, but Ho, Dy, and Tb are not efficiently separated. No separation of Nd and Pr was observed. (auth)

5604

THE ATOMIC HEATS OF THE RARE-EARTH ELEMENTS. D. H. Parkinson, F. E. Simon, and F. H. Spedding. Proc. Roy. Soc. (London) 207, 137-55(1951) June 22.

The atomic heats of La, Ce, Pr, and Nd have been measured from 2 to 180°K. La shows an anomaly corresponding to superconductivity at 4.37°K, and the atomic heat (C_p) rises to 6.2 cal/g atom at 180°K. The free electronic specific heat deduced from the low-temperature results appears to explain this high value satisfactorily. Ce, Pr, and Nd all behave anomalously. A specimen of Ce of face-centred cubic structure shows an anomaly between 90 and 180°K which exhibits large hysteresis effects. Taking into account the results of other research workers which have been published since this work was begun, this anomaly appears to correspond to the transition of the 4f electron to a 5d state. A second specimen of Ce in which both face-centred cubic and hexagonal close-packed structures were present did not show this anomaly. Both specimens, however, showed large anomalous humps in the low-temperature region at approximately 12°K. Pr shows a very large distributed anomaly which produced a maximum in the atomic heat curve at 65°K. Nd shows two anomalous peaks, one at 7.5°K and one at 19°K. These anomalies in Pr and Nd, together with the low-temperature anomaly in Ce, can be explained qualitatively by the view that the electronic states attributable to the 4f electrons are split by the electric fields existing within the metallic crystals. This effect is more complicated than with the magnetically dilute hydrated rare-earth salts, as magnetic interaction is probably very important. (auth)

5605

YTTRIUM OXYFLUORIDE. F. Hund. Z. anorg. u. allgem. Chem. 265, No. 1-3, 62-6(1951) June. (In German)

YOF has been prepared by the reaction of Y_2O_3 with YF_3 at 900°C in high vacuum. The compound is dimorphic; quenching with a slight excess of YF_3 produces the pure white β-YOF which is metastable at ordinary temperatures, whereas slow cooling produces the ivory-white α-YOF. β-YOF has a density of 5.18 at 25°C and crystallizes in the fluorite structure with a = 5.363 ± 0.001 A. α-YOF crystallizes in a structure similar to the β form but probably weakly distorted tetragonally. Powder diffraction data are tabulated.

5606

ON THE CERIUM DIOXIDE-URANIUM DIOXIDE SYSTEM AND "URANIUM CERIUM BLUE." Arne Magnéli and Lars Kihlborg. Acta Chem. Scand. 5, 578-80(1951).

Dark-blue cubic crystals of a cerium uranium oxide were obtained by Hoffmann et al. (Ber. 48, 20(1915)) and were considered by them a definite chemical compound $2CeO.UO_2$. The present authors, by studying x-ray powder photographs of the substance, established that this "cerium uranium blue" can be of variable composition, the products forming a continuous series of solid solutions $(Ce,U)O_2$ of a fluorite-type lattice.

5607

STUDIES OF ZEEMAN EFFECTS FROM SOLUTIONS OF EUROPIUM AND NEODYMIUM SALTS. George J. Rotaru. J. Chem. Phys. 19, 977-8(1951) July. (Letter to the editor)

Europic nitrate, ethylenediamine tetraacetate complexes of europic ions, and neodymium nitrate were used to study the Zeeman effect under a magnetic field of 31,000 gauss. In all cases studied the magnetic field did not alter the spectrum. This is contrary to Schmillan's results (Ann. Physik 39, 502 (1941)).

SEPARATION PROCEDURES

5608

Institute for Nuclear Studies, Univ. of Chicago

HOT ATOM CHEMISTRY OF BROMINE IN ORGANIC SYSTEMS; PART I, SECT. 1, p.1-6 of RESEARCH PROGRAM WITH THE CHICAGO CYCLOTRON; PROGRESS REPORT; AUGUST 1, 1949, to AUGUST 1, 1950. W. F. Libby, M. S. Fox, and F. S. Rowland. [nd] 6p. (NP-3182(p.1-6))

Samples of n- or iso-propyl bromides have been irradiated at various low temperatures in the cyclotron with a neutron flux of about 10^8 thermal neutrons/cm^2/sec for periods of 1 to 2 hr to produce the (n,γ) reaction in bromine. The retention of the recoil radiobromine was determined in the various propyl bromides. Striking increases in retention occurred when the solid phase was reached. Results are also reported of the retention of radiobromine in pentane irradiated at 25°C.

5609

Atomic Energy Research Establishment, Harwell, Berks (England)

THE EXTRACTION OF PHOSPHORUS 32 FROM PILE-IRRADIATED SULPHUR AT THE CURIE LEVEL OF ACTIVITY. W. J. Arrol. Mar. 2, 1951. 7p. (AERE-I/R-748)

Pile-irradiated S is melted and extracted with 0.2N HNO_3 at 130°C. $La(OH)_3$ is precipitated in this solution to hold the P^{32} (as the phosphate) while sulfate (including any S^{35} activity) is filtered off. The La precipitate is dissolved in HCl, evaporated to dryness, and taken up in 0.02N HCl for purification in a cation exchange column. Finally, H_2O_2 is added to destroy the last traces of organic matter. The apparatus used is diagramed.

5610

CONTINUOUS COUNTERCURRENT EXTRACTION OF A DISSOLVED SUBSTANCE FROM THE WATER PHASE BY AN ORGANIC SOLVENT. V. N. Kozlov and B. I. Smolenskiĭ. Zhur. Priklad. Khim. 23, 1290-8(1950) Dec. (In Russian)

Most formulas and graphical methods for computation of processes of extraction by organic solvents are not directly applicable to concrete technological problems, because in their derivation specific aspects of the processes have not

been taken into consideration. In an example, the extraction of acetic acid from water solutions by an organic solvent, optimal conditions of the operation are deduced and formulas are given for the determination of the number of sections in the column and of the final concentrations in both phases as a function of the nature of the solvent and of other factors.

5611
INORGANIC PAPER CHROMATOGRAPHY. SEPARATION POWER OF SATURATING AND DEVELOPING ORGANIC SOLVENTS. Alice Lacourt, Ghislaine Sommereyns, and Georges Wantier. Compt. rend. 232, 2426-8(1951) June 25. (In French)

Results obtained in paper chromatography are appreciably influenced by the degree to which the space surrounding the paper strips is saturated with vapors of the developer. Experiments in which that space was filled with vapors of a substance other than the developer resulted in satisfactory and reproducible separations of anions and cations present in quantities of the order of a μg. Using benzene or 2-butanone + HCl as a saturator, and acetone + HCl as a developer, separations of B from Si and Mo and of U from Fe and Al were made.

5612
SEPARATION OF SUBSTANCES WITH THE AID OF A FEEBLE POTENTIAL DIFFERENCE. J. Piguet, W. Kuhn, and H. Kuhn. Helv. Chim. Acta 34, 1183-202(1951) June 15. (In French)

By applying a feeble potential to an electrolytic cell, a separation of "inactive" ions (i.e., those ions which are not involved in chemical reactions on the electrodes) can be obtained; this primary enrichment is notably increased by establishing an appropriate circulation of the solution in the cell. An outline of the theory of the method (including cases of isotope separations) is followed by a description of experiments with solutions containing dissolved H_2.

5613
VACUUM EVAPORATION OF RADIOACTIVE MATERIALS. Chalmers W. Sherwin. Rev. Sci. Instruments 22, 339-41 (1951) May. (Laboratory and shop notes)

A description is given of a technique of vacuum evaporation of carrier-free P^{32}, Sr^{90}, and Y^{90}, by which monolayer sources of both P^{32} and Y^{90} have been formed. Y^{90} has been separated from Sr^{90} by a factor of 10^4. This method of performing chemical operations with carrier-free materials involves ordinary physics laboratory equipment and may not involve any special chemical techniques.

SORPTION PHENOMENA

5614
Sterling Chemistry Lab., Yale Univ.
ADSORPTION STUDIES ON CLAY MINERALS; I. CHROMATOGRAPHY ON CLAYS. Joseph A. Faucher, Jr., Raymond W. Southworth, and Henry C. Thomas. [nd] 12p. (AECU-1589)

With the aid of chromatographic columns containing a clay mineral dispersed on asbestos, ion-exchange processes on this mineral have been studied. The results of isotopic exchanges show that the columns do not run under equilibrium conditions. These isotopic exchanges do make possible a correction procedure which serves to produce isotherms for cases of true ion exchange. The details of the correction procedure are given together with some results for a Cs-Na exchange on a montmorillonite from Chambers, Ariz. The possibility of fixing radioactive wastes in clay minerals is considered briefly. (auth)

SPECTROSCOPY

5615
HYPERFINE STRUCTURE OF TECHNETIUM ($^{99}_{43}$Tc) SPECTRAL LINES. William F. Meggers and Karl G. Kessler. Physica 17, 484(1951) Mar.-Apr.

Very brief note is made of the observation of 2100 new spectral lines in the Tc I and Tc II spectra. Hyperfine structure is exhibited by many lines involving levels arising from electron configurations containing one 5s electron. Patterns for the wavelengths 4297.06 A and for 4031.63 A, although incompletely resolved, indicate that the mechanical moment of Tc^{99} nuclei may be $9/2.h/2\pi$ in agreement with the predictions of nuclear shell models.

5616
RADIOFREQUENCY SPECTRA OF H_2 AND D_2 BY A NEW MOLECULAR BEAM RESONANCE METHOD. Norman F. Ramsey. Physica 17, 388-19(1951) Mar.-Apr.

A new molecular-beam resonance method has been successfully applied to the study of the r-f spectrum of H_2 and D_2. The experimental resonance curve with D_2 is very similar to the theoretically predicted curve. In the new method the oscillating magnetic field is applied only as the molecule enters and leaves the homogeneous magnetic field instead of uniformly throughout the homogeneous field region. The optical analogue to the old method is diffraction from a slit whereas that to the new method is the Young's interference pattern from two slits or the Michelson stellar interferometer. Resonances by the new method are much sharper.

5617
THE M_{IV} AND M_V ABSORPTION EDGES OF Er. E. A. Stewardson and P. A. Lee. Proc. Phys. Soc. (London) 64A, 318-19(1951) Mar. (Letter to the editor)

Accidental observation of M_{IV} and M_V x-ray absorption edges for Er at 8583 X.U. and 8829 X.U., respectively, indicate that Lindberg's investigations (Nova Acta Regiae Soc. Sci. Upsaliensis 7, No. 7, 68(1931)) were made with insufficiently thick absorption films of Er; he failed to observe any sign of the normal M_{IV} and M_V edges but found instead a pair of narrow absorption lines close to the expected position of the M_V edge. Large negative L-M discrepancies for Er are calculated.

5618
THE INFRARED SPECTRUM OF SULFUR HEXAFLUORIDE. R. T. Lagemann and E. A. Jones. J. Chem. Phys. 19, 534-6(1951) May.

The infrared absorption spectrum of gaseous SF_6 has been investigated from 2 to 25 μ with prism spectrometers of high resolution. The frequencies of the infrared-active fundamentals found by earlier workers have been confirmed with the exception of one, formerly found at 965 cm^{-1}, which is shown to be at 940 cm^{-1}. However, the remainder of the spectrum differs considerably from previous work. With the aid of the Raman data, the observed spectrum has been interpreted in detail. (auth)

5619
FUNDAMENTAL RESEARCH IN ATOMIC SPECTRA. William F. Meggers. J. Optical Soc. Am. 41, 143-8(1951) Mar.

The discovery, refinement, and quantum interpretation of atomic energy levels is discussed generally for the period covering the past quarter century. A survey has been made which rates the fine-structure analyses of 504 spectra of 84 chemical elements, and quotes the nuclear moments for 184 isotopic species. 11 references.

SYNTHESES

5620

Pittsburgh Univ.

THE SYNTHESIS OF HETEROCYCLIC NITROGEN-CONTAINING KETONES; I. KETONES DERIVED FROM 2-PICOLINE (Contribution No. 815). Newton N. Goldberg, Lloyd B. Barkley, and Robert Levine. [nd] 8p. (NYO-682)

2-Picolyllithium, prepared from 2-picoline and phenyllithium, has been acylated in good yields with methyl benzoate, 2-furoate, 2-thiophenate, acetate, propionate, and isovalerate and ethyl benzoate and isobutyrate. In addition to the 2-picolyl ketones, alkyl di-2-picolylcarbinols (methyl, ethyl, isopropyl, or isobutyl) were isolated in those experiments in which aliphatic esters were used as the acylating reagents. (auth)

5621

Argonne National Lab.

[SYNTHESIS OF LABELED FORMALDEHYDE], p.71-5 of QUARTERLY REPORT NOVEMBER, DECEMBER 1950 AND JANUARY 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, Director. [nd] 5p. (ANL-4571(p.71-5))

In order to synthesize C^{14}-labeled formaldehyde, as a step toward indoleacetic acid, "cold" procedures were undertaken whereby CO_2 was reduced via $LiAlH_4$ to methanol, and the latter catalytically oxidized to formaldehyde. Yields of the latter up to 69% were obtained (based on original weight of $BaCO_3$ and dimedon derivative).

5622

MICROSYNTHESIS OF C^{14}-LABELED ANGULAR BENZACRIDINES. Pascaline Daudel, Monique Flon, Andrée Cheutin, Roland Muxart, N. P. Buu Hoï, Bernard Eckert, and Nguyen Hoan. Compt. rend. 232, 968-9(1951) Mar. 5. (In French)

The synthesis of the carcinogenic substances 7,9-dimethyl-1,2-benzacridine and 7,9-dimethyl-3,4-benzacridine, both labeled in the 9 (meso) position, by condensation of a N-arylnaphthylamine with labeled acetate in the presence of $ZrCl_2$ and HCl is described.

5623

THE SYNTHESIS OF 3,4-BENZPYRENE-5-C^{14} AND A PRELIMINARY SURVEY OF ITS DISTRIBUTION IN MICE. Charles Heidelberger, Helga S. Rieke, and S. Marguerite Weiss. Paper presented at a meeting of the American Association for Cancer Research, Inc., April 27-29, 1951.

An abstract of this paper appeared in Cancer Research 11, 255 (1951) April and is reproduced here in part.

The synthesis was carried out by modifications of the method of Hershberg and Fieser. Phenyl magnesium bromide was treated with 7 mc of $C^{14}O_2$ to give benzoic acid-carboxyl-C^{14} (94%), which was then converted into benzoyl chloride (87%). This compound was treated with perinaphthane in the presence of Al chloride to give benzoylperinaphthane-carbonyl-C^{14} (89%). Ring closure with aluminum chloride followed by Zn dust distillation gave crude yellow benzopyrene-5-C^{14} (42%), which was purified by extensive chromatography on alumina (70%). The over-all yield, based on $BaCO_3$, was 22%. The specific activity was 2.8 $\mu c/mg$.

5624

PREPARATION AND PROPERTIES OF THE OXIDE-SULFIDES OF CERIUM, ZIRCONIUM, THORIUM, AND URANIUM. E. D. Eastman, Leo Brewer, LeRoy A. Bromley, Paul W. Gilles, and Norman L. Lofgren. J. Am. Chem. Soc. 73, 3896-8(1951) Aug.

The preparation, properties, and nomenclature for the oxide-sulfides of cerium, zirconium, thorium, and uranium are discussed. The compounds Ce_2O_2S, ThOS, UOS, and ZrOS have been prepared by the reaction of an oxide with sulfur or hydrogen sulfide. The crystal structures and lattice constants are given in Table I. The color, solubility, melting behavior, high temperature chemistry, and estimated thermochemistry are described. (auth)

5625

THE SYNTHESIS OF C^{14}-LABELED GLYCEROL. Hermann Schlenk and Bernice Wallace DeHaas. J. Am. Chem. Soc. 73, 3921-2(1951) Aug.

Glycerol-1,3-C_3^{14} has been prepared in over-all yield of 19%, by condensing nitromethane with paraformaldehyde-C^{14}, followed by reduction and diazotization. (auth)

TRACER APPLICATIONS

5626

Arkansas Univ.

CRITERIA OF PURITY IN HOT-ATOM CHEMISTRY AND BIOLOGICAL TRACER STUDIES. D. R. Smith. [nd] 2p. (AECU-1475)

The report is reproduced here in its entirety.

One of the most valuable functions of radioactive isotopes in research involves their ready detection in very minute concentrations. Thus, the use of "tagged" compounds enables the worker to conduct investigations in previously undetectably low concentrations.

The very sensitivity available in such studies is the source, however, of a serious problem regarding research in the biological field and the newer hot-atom chemistry problems. The problem is: How can one ascertain with certainty that the tagged molecules of interest in a particular investigation are literally free from contamination by other compounds which are tagged with the same radioactive isotope? The solution is relatively simple by ordinary chemical means if the degree of labeling is the same in both the contaminant and the substance under study. However, both hot-atom and biological tracer studies must take into account the certainty that contamination by materials of relatively very high specific activity may be involved.

There appear to be two general means available for proof that impurities of very high specific activity are absent. First, every constituent of a sample may be identified, and, by the use of suitable carriers, the individual impurities may be isolated and their specific activity determined. In practice, it will always be impossible to identify every impurity. In addition, the exact extent of the removal of an impurity of high specific activity cannot be determined.

The second approach which may be used in determining the complete removal of highly radioactive impurities is complete purification of the compound under consideration. The proof of complete purification must at present be empirical. Purification and derivatization involving every possible procedure, wherein no change in specific activity is observed would be accepted as reasonably good evidence that complete purification had been attained. There would, however, be no certainty that radioactive impurities had been completely removed.

In actual practice, a high counting rate, constant with repeated and varied purification, is usually accepted as sufficient proof of purity. The problem cannot be solved conclusively by existing methods if the sample has a low counting rate, as this would permit the possibility of extremely low concentrations of highly active impurities.

5627

STUDY OF BROMINE-EXCHANGE REACTIONS BY THE METHOD OF RADIOACTIVE INDICATORS. Ya. A. Fialkov and Yu. P. Nazarenko. Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, 590-8(1950) Nov.-Dec. (In Russian)

By using bromides of 28 elements from various groups of the periodic table, isotopic exchanges of Br were studied in systems composed either of a bromide and free Br, or of

two different bromides. The homogeneity of the reaction mixture was recognized as the main condition determining a rapid and complete isotopic exchange; this condition is satisfied in an aqueous or nonaqueous solution of Br + bromide, in a solution of a bromide in Br, or in a solution of Br in a molten bromide. Mechanisms involving transient formations of complex compounds or, perhaps, of polyhalogenides, can explain these facts. In some cases, reduction-oxidation and thermal dissociation-association sequences can also be traced.

5628

ISOTOPIC EXCHANGE BETWEEN D_2O AND $NaBH_4$. Peter R. Girardot and Robert W. Parry. J. Am. Chem. Soc. 73, 2368(1951) May. (note)

Approximately 1.5 molal solutions of $NaBH_4$ were prepared in evaluated systems using 99.8% D_2O as the solvent. Hydrolysis of the $NaBH_4$ was reduced to a negligible amount by saturating the solution with $Ca(OD)_2$ (pH about 12). After standing 17.5 hr at 20 to 25°C, the D_2O was distilled off, dry oxalic acid was added to the alkaline $NaBH_{4-x}D_x$ residue, the system was reevacuated, and hydrolysis was effected by adding distilled water to the acid mixture. The reaction was $Na(BH_{4-x}D_x) + 2H_2O \rightarrow NaBO_2 + zHD + (4-x)H_2$. The upper limits for the HD:H_2 ratios ranged from 2.2×10^{-4} to 8×10^{-4}. Natural abundance gives a D:H ratio reported variously as 1.45×10^{-4} and 1.61×10^{-4}. It is apparent that the values found do not indicate formation of significant amounts of HD, and it is concluded that the H of $NaBH_4$ does not exchange with H of water.

5629

INVESTIGATION OF THE NONHOMOGENEITY OF ACTIVE SURFACES BY THE DIFFERENTIAL ISOTOPIC METHOD. I. ACTIVE SURFACES OF METALLIC NICKEL AND OF ZINC OXIDE. N. P. Keier and S. Z. Roginskiĭ. Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, 27-38(1950) Jan.-Feb. (In Russian)

Tagged D_2 and H_2 molecules are used in a "differential isotopic method" for a study of surfaces of catalytically-active samples of Ni and ZnO. The nonhomogeneity of contacts in both cases is demonstrated and is shown to account for the observed anomalies in the adsorption kinetics. (auth)

TRITIUM AND TRITIUM COMPOUNDS

5630

QUANTITATIVE MEASUREMENT OF SAMPLES OF TRITIUM. J. H. Frisby and D. Roaf. Proc. Phys. Soc. (London) 64B, 169-71(1951) Feb. (Letter to the editor)

An apparatus designed to determine quantitatively the amount of tritium present in a target gas is described and diagramed. The gas was put inside a G-M counter, and to keep the wall effect small it was decided to use at least 10 cm Hg pressure of A in the counter and a diameter of 1 7/16 in. A quenching unit with a quenching time of up to 1,000 μsec was constructed.

URANIUM AND URANIUM COMPOUNDS

5631

Oak Ridge National Lab., Y-12 Area

STUDIES IN THE CARBONATE-URANIUM SYSTEM; PART II. THE SOLUBILITY OF SODIUM URANYL TRICARBONATE IN SOLUTIONS OF CERTAIN SODIUM SALTS. K. B. Brown and J. M. Schmitt. Oct. 20, 1950. Decl. Sept. 6, 1951. 28p. (AECD-3229; Y-678)

Determinations have been made of the solubility of sodium uranyl tricarbonate, $2Na_2CO_3.UO_2CO_3$, in water and in aqueous solutions of Na_2CO_3, $NaHCO_3$, Na_2SO_4, NaCl, and $NaClO_4$. The solubility is presented in its relation to the molarity of the cosolute, and the solubility product is presented in its relation to the total ionic strength. The data are also considered as to their bearing on plant processes such as those employed in the carnotite mill at Monticello, Utah. (auth)

5632

Oak Ridge National Lab.

UNDISSOCIATED SPECIES AND DIMERIZATION IN AQUEOUS SOLUTIONS OF URANYL FLUORIDE. James S. Johnson and Kurt A. Kraus. [nd] Decl. Sept. 7, 1951. 7p. (AECD-3236; ORNL-1070(draft))

Consideration of data (Secoy, UCRL-795) on freezing-point depression of aqueous uranyl fluoride solutions indicates that the predominant reaction is $2UO_2F_2 \rightleftharpoons (UO_2F_2)_2$, although dissociation of the monomer must be considered at low concentrations. The exact extent of dimerization is not established, but the dimer is the predominant species above 0.5M.

5633

METALLIC URANIUM. Atomes 6, 169(1951) May. (In French)

A short description is given of the method for the preparation of pure metallic U, due to Eichner, Goldschmidt, and Vertes, and used by the French Atomic Energy Commission in its plant at Bouchet, near Paris. Pure UO_2 is transformed into UF_4 which yields U through the action of Ca.

5634

PREPARATION OF PURE URANIUM AND GRAPHITE FOR NUCLEAR REACTORS. R. Cyprès. Rev. cercle sci. univ. libre Bruxelles 1, 16-19(1950) Nov. (In French)

A brief description is given of procedures for purification of U and graphite destined for nuclear reactors.

5635

THE OXIDES OF URANIUM. PART II. THE BINARY SYSTEM UO_2—CaO. K. B. Alberman, R. C. Blakey, and J. S. Anderson. J. Chem. Soc., 1352-6(1951) May. (See also NSA 4-4277)

The phase diagram of the system of CaO-UO_3 has been investigated in the temperature range 1650 to 2300°C. The eutectic temperature is 2080 ± 20°C and the eutectic composition about 45 mole % of UO_2 and 55 mole % of CaO. The CaO takes no detectable amount of UO_2 into solid solution, but the UO_2 forms solid solutions with defective fluorite structure, the saturated solid solution containing 47 mole % of CaO at the eutectic temperature. The concentration of CaO in the saturated solid solution decreases with falling temperatures, down to 20 mole % at 1650°C. At 1750°C and below, two compounds are formed: Ca_2UO_4 (= $2CaO.UO_3$), a tetragonal double oxide of unknown structure; and $CaUO_3$ (= $CaO.UO_2$), having a cubic cell with a = 10.727 ± 0.002 kX. The structure of the latter is equivalent to the type-C rare-earth oxide structure with $Ca^{+2} + U^{+4}$ replacing $2M^{+3}$. (auth)

5636

NATURAL BLACK URANIUM POWDER. Paul F. Kerr. Science 114, 91-2(1951) July.

The soft, black, U-bearing powder found at Bellvue-Rochester mine in Colorado and White Canyon and Marysvale in Utah has been studied from the standpoint of origin and distribution. It is concluded that solutions and complete submersion, rather than simple weathering and surface oxidation, must be responsible for the sooty material. Since the mineral is prevailingly uraninite and occurs in a hydrothermal environment, it is suggested that the solutions from which precipitation occurred were heated.

5637

NEW URANIUM DETERMINATIONS IN SAMPLES OF SEA WATER. Gerta Koczy. Sitzber. Österr. Akad. Wiss. Math. naturw. Klasse Abt. IIa 158, 113-21(1950). (In German)

Whereas measurements by Hernegger and Karlik (Sitzber. Akad. Wiss. Wien Math. naturw. Klasse Abt. IIa, (1935)) showed a quasi constancy of the U content in sea water from various points of the oceans, and a small dependence on the depth, Rona (Yearbook Am. Phil. Soc., 136(1948)) found, besides much lower average contents, a wide range of values. The present author's measurements, in which a large collection of samples assembled by the Swedish expedition of the Albatross (1947-8) was used, confirmed the results obtained by Hernegger and Karlik: the U content at the surface of all oceans oscillates feebly around the mean value of 1.1×10^{-6} g/liter; after reaching a maximum of about 1.4×10^{-6} g/liter at the depth of ~1000 m, it decreases by 10 to 20% toward the bottom. The discrepancies with Rona's results can be explained by surmising that samples used by her had not been acidified carefully enough before storage; experiments show that HCl prevents U from being deposited on the glass container walls.

5638

URANIUM MINERALIZATION IN BRITISH COLUMBIA. John S. Stevenson. Econ. Geol. 46, 353-66(1951) June-July. (See also NSA 5-137)

Where uranium-bearing veins have been found in British Columbia, the uranium mineral is the crystalline variety of uranium oxide, uraninite, rather than the amorphous colloform variety, pitchblende, that is found in the Great Bear Lake deposit and in occurrences of similar type elsewhere in the Precambrian shield. The British Columbia uraninite is not found in granite pegmatites such as the occurrences in eastern North America but rather in gold-bearing metallic veins. In these veins, the uraninite is associated with cobalt-nickel sulfarsenides similar to those found in normal mesothermal pitchblende deposits, but the other associated metallic minerals, arsenopyrite and molybdenite, and the gangue minerals, hornblende, feldspar, apatite, scheelite, monazite, and allanite, indicate that the veins are hypothermal rather than mesothermal. (auth)

5639

THE URANYL:CITRATE SYSTEM. II. POLAROGRAPHIC STUDIES OF THE 1:1 COMPLEX. W. F. Neuman, J. R. Havill, and Isaac Feldman. J. Am. Chem. Soc. 73, 3593-5 (1951) Aug.

Polarographic studies in acid solution with an excess of citrate showed that the 1:1 uranyl citrate complex was present as a dimer and was reduced according to the reactions: (a) $(U(VI):citrate)_2 + mH^+ + 2e = 2U(V):citrate$; (b) $U(V):citrate + nH^+ + e = U(IV):citrate$. m and n were approximately unity at pH 4.6 but increased with decreasing pH. (auth)

ENGINEERING

HEAT TRANSFER AND FLUID FLOW

5640

Knolls Atomic Power Lab.

ENGINEERING ASPECTS OF THE USE OF LIQUID METALS FOR HEAT TRANSFER; by T. Trocki. Sept. 8, 1951. 14p. (AECU-1608)

The advantages of liquid metals in heat-transfer systems are shown by comparing the tabulated thermal properties at high temperature and required pumping power of Na, NaK, heat-transfer salt ($NaNO_2$-$NaNO_3$-KNO_3), Dowtherm A, Hg, Pb, Pb-Bi eutectic, Li, and H_2O. Problems of liquid-metal handling and safety, construction of piping and heat exchangers, pumping methods, and purification requirements are discussed.

5641

EFFECT OF THE VELOCITY OF A MOVING AND BOILING LIQUID ON HEAT EXCHANGE. N. G. Styushin and L. S. Sterman. Zhur. Tekhĭ. Fiz. 21, 448-52(1951) Apr. (In Russian)

The role of the velocity of forced circulation on heat transfer in a boiling liquid is experimentally evaluated. The intensity of the heat exchange grows with the velocity. This effect of the velocity is a function of the thermal-flow value. The results are worked out in dimensionless coordinates.

5642

HEAT TRANSFER TO A FLUID FLOWING TURBULENTLY IN A SMOOTH PIPE WITH WALLS AT CONSTANT TEMPERATURE. R. A. Seban and T. T. Shimazaki. Trans. Am. Soc. Mech. Engrs. 73, 803-9(1951) Aug.

The case of heat transfer to an incompressible fluid of constant properties flowing turbulently within a pipe having constant wall temperature has been investigated analytically. Heat-transfer coefficients have been evaluated and compared to the coefficients obtained by Martinelli for the same flow conditions in a pipe having a linear variation of wall temperature obtained from a constant heat-transfer rate along the pipe length. At low Prandtl numbers, such as obtained with molten metals, the ratio between the coefficients for these two cases may become as low as 0.73, with the coefficient for the constant-wall-temperature case being the smaller of the two. A simple equation of the Lyon type is indicated for the correlation of the present results.

5643

THE EFFECT OF PRESSURE ON THE MECHANISM OF STEAM FORMATION IN A BOILING LIQUID. L. M. Zysina-Molozhen and S. S. Kutateladze. Zhur. Tekh. Fiz. 20, 110-16 (1950) Jan. (In Russian)

An experimental study of the mechanism of formation of vapor bubbles in a boiling liquid, under conditions of free circulation, showed the inadequacy of formulas frequently used for the calculation of the intensity of heat exchanges emanating from the German school of workers (Fritz, Physik. Z., No. 11(1935); Jacob and Linke, ibid., No. 8(1936)); these formulas do not reflect the true role played by pressure in the mechanism of boiling.

5644

SOLUTION OF A HEAT FLOW PROBLEM. J. R. M. Radok. Australian J. Sci. Research 4, 12-15(1951) Mar.

This paper deals with the heat flow through a rectangle subject to the following boundary conditions: One end is completely insulated (without heat flux across it) and at the opposite end a constant temperature gradient is maintained; the remaining sides radiate into a medium which is at zero temperature. Initially the rectangle is at zero temperature. The problem is converted into a homogeneous one by considering a rectangle of twice the length with a uniformly distributed heat source along the center line. The solution of this problem is effected by using particular solutions given in Carslaw and Jaeger. The problem considered is of interest in connection with the testing of heat-insulating materials. (auth)

5645
COMMENT ON "GAS BUBBLES IN SOLUTIONS." Frank C. Roesler. J. Chem. Phys. 19, 512-3(1951) Apr.

Epstein and Plesset (J. Chem. Phys. 18, 1505(1950)) have derived formulas for growth and dissolving of gas bubbles in a liquid phase when transport of the dissolved gas takes place by diffusion only. A theoretical discussion is presented of the opposite limiting case, in which the mechanical motions in the system more than match the diffusion.

5646
HEAT CONDUCTION IN SIMPLE METALS. M. L. Storm. J. Applied Phys. 22, 940-51(1951) July.

The partial differential equation of heat conduction is a nonlinear equation when the temperature dependence of the thermal parameters (i.e., the thermal conductivity, K, and S, the product of the density and the specific heat at constant pressure) is taken into account. It is shown that a mathematical condition for the transformation to linear form of the one-dimensional, nonlinear, partial differential equation of heat conduction is the constancy of $[1/(KS)^{1/2}]$ $(d/dT)\log(S/K)^{1/2}$. This discovery is the motivation for an investigation of the relations between the thermal parameters of simple metals on the bases of the theory of solids and available experimental data. It is found that KS is essentially constant, its variation with temperature being much less than that of either K or S considered separately. It is also shown, as a result, that the condition for the above-mentioned transformation is valid for simple metals. Applications of the transformed equation to the solution of problems in heat conduction are considered. (auth)

MATERIALS TESTING

5647
ON CREEP AND RELAXATION. III. B. Gross and H. Pelzer. J. Applied Phys. 22, 1035-9(1951) Aug.

The previous theory of linear reversible creep is extended and permanent (plastic) deformations are taken into consideration. General relations are established between the distribution functions of relaxation times of stress, and retardation times of strain. A particular type of distribution function is considered in detail and it is discussed in a qualitative way how the existence of a plastic component in creep affects the distribution function of relaxation times. (auth)

TRACER APPLICATIONS

5648
MEASURING THE THICKNESS OF THIN COATINGS WITH RADIATION BACKSCATTERING. Eric Clarke, J. R. Carlin, and W. E. Barbour, Jr. Elec. Eng. 70, 35-7(1951) Jan.

The thickness of thin coatings can be measured nondestructively by the backscatter of radiation if the atomic number of the coating is different from the material to which the coating is applied. The detecting head and radioactive source, separated by a suitable radiation shield, are mounted in the same instrument head on the side on which the coating is being applied. The sensitivity of the described gauge is extremely high for thin films.

VACUUM SYSTEMS

5649
A COMPACT SLIDING VACUUM SEAL. R. I. Garrod. J. Sci. Instruments 28, 187(1951) June. (Laboratory and workshop notes)

A description is given of a sliding vacuum seal designed for applications in which the axial separation between two elements in a vacuum system is restricted, so that the use of a bellows-type seal is impracticable. Although this seal was designed originally to provide translational movements, it has in fact been found to serve equally well if rotation of one element of the vacuum system with respect to the other is required.

5650
SILICONE OIL VAPOUR AND SECONDARY ELECTRON EMISSION. A. Lempicki and A. B. McFarlane. Nature 167, 813-14(1951) May 19. (Letter to the editor)

The current tendency to use oil instead of Hg vapor in diffusion pumps has prompted experiments on secondary electron emission using silicone oil. The "sticking" potential, defined as the higher of the two potentials at which the secondary emission coefficient δ is unity, was determined for a fluorescent powder at a pressure of 5×10^{-6} mm Hg. Under electron bombardment the secondary emission fell within 30 min, and the sticking potential fell from 8 to 12 kv to 2.5 kv. In another series of experiments conducted at a pressure of 2 to 3×10^{-6} mm Hg, the secondary emission coefficient was measured for various surfaces in an orbital beam electrode system, and the value of δ was found to fall rapidly under electron bombardment. Eventually, after repetition of decay and recovery by heating, the secondary cathode became coated with a dark deposit, and the value of δ was then permanently lowered. It is concluded that great care should be exercised in interpreting results of experiments performed in vacua containing silicone vapor.

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

5651
HEAT-RESISTANT CERAMIC COATINGS. Steel 129, 74-7, 96, 100(1951) Aug. 13.

A general discussion and review of the literature on heat-resistant ceramic coatings on steel is presented.

5652
PROPERTIES OF ZIRCON FUSED IN A SOLAR FURNACE. Félix Trombe, Marc Foëx, and Jean Wyart. Compt. rend. 233, 172-3(1951) July 9. (In French)

Zircon (m.p. 2680°C) was fused in a solar furnace in a continuous procedure permitting the preparation of refractory pieces weighing several hundred grams at a rate of 250 g/hr. The pieces can be cemented together by local fusion. This remarkable property of fused zircon and its high resistivity to cracking as compared with that of the sintered (at 1800°) product are related to its favorable dilatometric properties, especially important at the temperature of the crystallographic transformation of zircon around 1000°.

5653
ZIRCONIA REFRACTORY GOOD TO 4600°F. Steel 128, No. 5, 68(1951) Jan. 29.

A new fused stabilized zirconia refractory is briefly described. It will successfully withstand industrial temperatures up to 4600°F. A brief résumé of the properties of ZrO_2 is given. The importance of crystal composition is noted. Uses to which the material can be put include a

variety of molded shapes, such as furnace-lining bricks for gas synthesis at high temperatures in the chemical industry; setter plates for firing titanates used in the construction of capacitors in the electronic equipment field; heating elements for electric furnaces; containers and conveyers for molten steel; and thermal insulation (high-frequency induction- or resistor-wound furnace).

GEOLOGY AND GEOPHYSICS

5654

ON A POSSIBLE SOURCE OF ERRORS IN GEOLOGIC-AGE DETERMINATIONS WITH THE AID OF URANIFEROUS MINERALS. Boris Brajnikov. Compt. rend. 233, 74-5 (1951) July 2. (In French)

Determinations of the geologic age of uraniferous minerals by the Pb-isotope methods show deviations from a curve giving the age as a function (1) of the ratio U^{235}/U^{238} in the mineral at the time of its formation and (2) of that ratio in the present-day natural U. Whereas the spontaneous fission of U is too slow to account for these deviations, it is not impossible that they may be due to U fissions produced by neutrons of cosmic or telluric origin.

5655

RELATIVE ABUNDANCES OF OXYGEN AND CARBON ISOTOPES IN CARBONATE ROCKS. P. Baertschi. Nature 168, 288-9(1951) Aug. 18. (Letter to the editor)

The relative differences in the ratios O^{18}/O^{16} and C^{13}/C^{12} of some 150 carbonate rocks, including 14 sedimentary limestones, 90 metamorphic limestones, 20 intrusive carbonatites, 12 calcite crystals from Alpine clefts, and 7 calcareous sinters, have been measured by a mass spectrometer. Considering the average isotopic composition of the different groups of carbonate rocks, it was found that the sedimentary limestones exhibit the highest abundances of the heavy isotopes. The calcareous sinters precipitated from fresh water were strikingly low in C^{13}. The Alpine calcite crystals crystallized from hot solutions have the lowest abundances of heavy isotopes of all carbonates so far investigated. Results are interpreted in terms of temperature of formation and distance from contact zones.

METALS AND METALLURGY

5656

NEPA Div.

ENTHALPY, MEAN HEAT CAPACITY, AND ABSOLUTE HEAT CAPACITY OF SOLID AND LIQUID LITHIUM; PRELIMINARY; by A. M. Cabbage. Mar. 31, 1950. Decl. Sept. 18, 1951. 12p. (AECD-3240; NEPA-1370; SCR-58)

The least-squares equation for the variation of mean heat capacity of liquid Li with temperature was found to be $\bar{c}^{t}_{plss} = 1.31 - 0.00039\ t$ (cal/g/°C), where t is the furnace temperature in °C. This equation fits the data within about ±20% in the range 500 to 1000°C and may be extrapolated with somewhat greater uncertainty to the melting point, 186°C. The equation $H^{t}_{25} = 203 + 0.7\ t$ (cal/g), where t is the furnace temperature in °C, fits the enthalpy data within ±10 to 15% in the range 500 to 850°C and within ±30% in the range 850 to 1000°C. From the slope of this straight line was found the absolute heat capacity of liquid Li, $c_p = 0.7 \pm 0.1$ cal/g/°C for the range 500 to 850°C and 0.7 ± 0.2 cal/g/°C for the range 850 to 1000°C. Using literature values for the enthalpy of liquid Li at the melting point, an approximate equation was obtained for the enthalpy of Li between 186 and 500°C. The first derivative of this equation gave the following equation for the absolute heat capacity in the same temperature range: $c_p = 1.6$ to $1.1 \times 10^{-3}\ t \pm 0.3$ (cal/g/°C). Mean heat capacity values for solid Li from 25 to 150°C were also determined. An average value of $c_p = 0.6$ cal/g/°C was obtained.

5657

Knolls Atomic Power Lab.

NEW ELASTIC CONSTANTS OF SOME METAL; by Myron B. Reynolds. May 1, 1951. 85p. (AECD-3242; KAPL-576)

The ultrasonic pulse technique for measurement of elastic constants of solids is reviewed. The elastic constants of brass, Be, Nb, Zr, Th, V, Ti, U, and 347 stainless steel have been measured, and are compared with literature values where these exist. A mathematical appendix outlines the subject of the elasticity of solid materials for the case of plane waves in an infinite medium.

5658

Atomic Energy Research Establishment, Harwell, Berks (England)

PHOTO-EFFECTS WITH OXIDE COATED TANTALUM ELECTRODES; by L. Young. July 17, 1951. 54p. (AERE M/R-711)

The photoconductive and photovoltaic effects shown by Ta electrodes immersed in solution with progressively thickened films of oxide produced by anodic polarization have been investigated. The available range of thickness was from 10 to 20 A (two or three layers of oxide) to several thousand Angstrom units. The thickness was calculated from the capacity of the electrode. This method was checked by examining interference colors, and also by estimating the current required for formation. The photo and dark currents were determined as functions of field and thickness. A photoconductive effect also occurs with x rays.

5659

Atomic Energy Research Establishment, Harwell, Berks (England)

A REVIEW OF SOME EFFECTS OF LIGHT ON ELECTROCHEMICAL AND CORROSION PROCESSES ON METALS; by L. Young. June 1950. 10p. (AERE M/TN-2)

Published literature dealing with the effect of light on electrochemical processes is reviewed. Some of the effects discussed are the acceleration of oxidation of Al in air by ultraviolet light, production of a potential difference between two metallic electrodes in an electrolyte when one is illuminated, reduction of overpotential by ultraviolet light, and increase in wet-corrosion rates under illumination. Possible explanations of these processes advanced by several authors are included. 40 references.

5660

Atomic Energy Research Establishment, Harwell, Berks

GAS PHASE REACTIONS OF ZIRCONIUM; A REVIEW OF THE LITERATURE; by J. Laing. Apr. 26, 1951. 15p. (AERE M/TN-7)

Published information on the gas-phase reactions of Zr is reviewed. The following general conclusions can be drawn: H_2 reacts with Zr in much the same way as it does with Pd. With most other gases little significant attack occurs below 400°C. Above this temperature Zr reacts with O_2, N_2, CO, CO_2, water vapor, propane, NH_3, and SO_2, the rate increasing rapidly with increase of temperature. It seems probable that only the inert gases are stable toward Zr at high temperatures. The reaction products, such as ZrO_2 and ZrN, are soluble in the metal and greatly influence its physical properites. No significant improvement in oxidation resistance is obtained by alloying. 39 references. (auth)

5661

General Electric Research Lab.

GENERAL ASPECTS OF METALLIC BINARY PHASE DIAGRAMS. R. A. Oriani. Aug. 1951. 22p. (SO-2016; RL-578)

It is of interest to ascertain how successfully the general features of binary phase diagrams can be correlated with invariant atomic properties of the pure constituents. After

tabulating Pauling's metallic radii for coordination number 12, single-bond covalent radii, electronegativities, numbers of electrons in the valence shell, and Hildebrand's solubility parameters for 51 metallic elements, the author calculates various difference parameters from among these properties for 170 binary systems selected from the literature. Only a moderate degree of success in correlating the properties of the alloys with values predicted from the parameters is shown. The attempt may be regarded as a broad survey or crude framework from which one can proceed to fill in areas of ignorance. The scheme has some moderate predictive value for unknown binary systems, and the degree of probability increases sharply if the parameters calculated for the unknown binary are compared only with those of known binaries of metals of the same periodic family.

5662

Stanford Univ. School of Mineral Sciences

INVESTIGATION OF MATERIALS FOR USE IN HEAT TRANSFER SYSTEM CONTAINING LIQUID LEAD ALLOYS (Report No. XII); FINAL REPORT. O. Cutler Shepard and Ralph Parkman. June 11, 1951. 33p. figs. (ORO-45)

Results are summarized of unstressed corrosion tests of Mo, W, Ta, Nb, 446 stainless steel, Ti, and Zr in molten Pb and in molten Bi; stress-rupture tests of Mo, Ta, Nb, and type 446 stainless steel at 1500°F; solubility studies of Fe and Mo in molten Pb; and investigations on the wetting of solid metals by molten Pb and Bi.

5663

Knolls Atomic Power Lab.

THE ORIGIN OF RECRYSTALLIZATION TEXTURES. J. E. Burke. July 25, 1951. 6p. (AECU-1610)

The origin of crystallization textures is considered. Two hypotheses are discussed: (1) the oriented-nucleation hypothesis, whereby it is assumed that a recrystallization texture occurs because only grains having a limited range of orientations ever appear in the deformed matrix, and (2) the oriented-growth hypothesis, which assumes that grains essentially having all orientations are nucleated but that those having certain orientations grow much more rapidly than any others in the deformation texture, and thus only the rapidly growing grains survive when recrystallization is complete. Evidence from the literature is presented, most of which favors the idea that oriented nucleation operates in addition to oriented growth. Thus, while oriented growth may permit a selection to be made among nuclei of several orientations, only a limited number of orientations are available in the first place for such selection.

5664

Ames Lab.

SUBLIMATION OF ZIRCONIUM TETRAFLUORIDE. Louis J. Abate and Harley A. Wilhelm. Mar. 1951. 35p. (ISC-151)

Sublimations of ZrF_4 were carried out in vacuum in the range 750 to 1100°C. The over-all rate for complete sublimation of the charge varied linearly with temperature from 5.5 g/min at 750°C to 22.1 g/min at 1100°C. At the higher temperatures the vapor pressures of the impurities became appreciable and the product was contaminated. Optimum operating temperature was found to be 800 to 850°C. A study of the effect of pressure on per cent ZrF_4 sublimed showed that best results (a yield of 95.4% ZrF_4) were obtained at ~300μ. Type 309 stainless steel with either monel or Ni lining and a condensing surface of either monel or Ni proved satisfactory for construction of the apparatus. Under these conditions ZrF_4 was successfully separated from less volatile metallic impurities, moisture, and nonvolatile Zr compounds.

5665

Royal Aircraft Establishment, Farnborough, Hants (England)

THE THERMAL EXPANSION COEFFICIENTS OF CHROMIUM, TITANIUM, AND ZIRCONIUM CARBIDES. J. A. Graham. Aug. 1950. 15p. (RAE-TN-MET-130)

The coefficients of linear thermal expansion of sintered compacts of Cr, Ti, and Zr carbides have been determined over the temperature range 20 to 960°C. Ti and Zr carbides have similar coefficients, viz., 7.9 and 7.5×10^{-6}, respectively, over this range whereas that of Cr carbide (Cr_3C_2) is 10.2×10^{-6}. The accuracy of the results is considered to be within ±3%. (auth)

5666

Brookhaven National Lab.

PROPERTIES AND REQUIREMENTS OF MATERIALS IN NUCLEAR ENGINEERING. David H. Gurinsky. [nd] 5p. (AECU-1606)

Brief note is made of the necessity, in the selection of materials for nuclear engineering, for taking into account the radiation absorption cross sections. The effect of neutron irradiation on lattice structure is briefly described.

5667

Royal Aircraft Establishment, Farnborough, Hants. (England)

ALLOYS OF TITANIUM WITH OXYGEN AND NITROGEN. D. A. Sutcliffe. Mar. 1951. 11p. (RAE-TN-MET-141)

The effect of the interstitial solutes oxygen and nitrogen on properties of Mg-reduced titanium has been investigated. The alloys were prepared by melting in an argon arc furnace. Tensile tests were carried out at room temperature and 500°C. It was not possible to prepare threaded tensile-test pieces from alloys containing more than 0.5% oxygen (with 0.03% N) or 0.26% N (with 0.24% O). The embrittling effect of O and N in the alloys tested was not so pronounced at 500°C as at room temperature, but the increase in tensile strength at 500°C over pure Ti was not sufficient to be of practical importance. Microscopic and x-ray examinations showed that O and N were soluble in a Ti up to at least 1.0%. (auth)

5668

Royal Aircraft Establishment, Farnborough, Hants. (England)

X-RAY DIFFRACTION STUDIES IN RELATION TO CREEP. Catherine M. Luff and Edna M. Smith. Jan. 1951. 18p. (RAE-R-MET-64)

X-ray diffraction methods were used to investigate plastically deformed specimens of high-purity Al and two Al-Ag alloys containing 2 and 8% Ag, respectively. It was shown that the lattice distortion caused in high-purity Al by cold work is reduced by further deformation at an elevated temperature and can be removed almost entirely by creep, and that precipitated particles in the grains prevent the breakdown of the latter into strain-free fragments during creep. In general these results support the hypothesis that during creep in a pure metal an array of dislocations is formed. It is suggested, however, that contrary to earlier ideas, polygonization of the grains probably takes place to some extent during all deformations at about 300°C, the degree of perfection of the dislocation array varying with the rate of deformation. X-ray diffraction photographs of the specimens are shown.

5669

Metals Research Lab., Carnegie Inst. of Tech.

ELECTROCHEMICAL STUDIES OF NON-AQUEOUS MELTS; QUARTERLY PROGRESS LETTER; PERIOD ENDING MARCH 1, 1951. [nd] 22p. (AECU-1451)

A dropping-tin polarographic cell with H_2 atmosphere is described in which it is planned to obtain the decomposition potentials of Ni, Fe, and Cu chlorides in a LiCl-KCl eutectic

(m.p. 355°C). The high value of ~100/ohm-cm was obtained for the electrical conductivity of a molten 50-50 mole % Cu_2S-FeS matte in an immersed-tube cell; applications in the field of process metallurgy and pure chemistry are suggested, and a more accurate conductivity cell being constructed is sketched. A diffusion pressure cell for the measurement of transport numbers and conductivity in iron-silicate slags is diagramed. Preliminary results of experiments on the electrolysis of certain salts ($TiCl_4$, $CrCl_3$, Cu_2Cl_2) in solution in LiCl-KCl eutectic being carried out in an endeavor to determine the conditions under which the metals involved may be plated out of solution are summarized. The finding that a frequency of 35,000 Mc would be required to obtain dielectric values for slags has caused this project to be abandoned.

5670

ENGINEERING MATERIALS MANUAL. T. C. DuMond, ed. New York, Reinhold Publishing Corp., 1951. 386p.

Physical and processing characteristics, choice of casting or machining methods, finishing, etc., of standard and stainless steels, Al and Mg alloys, Ni and high-Ni alloys, bronzes, beryllium copper, and bearing metals are tabulated and discussed. Chapters on cemented carbides, ceramics for engineering applications, rubber plastics, etc., are included.

5671

THERMOELECTRIC PROPERTIES OF TITANIUM WITH SPECIAL REFERENCE TO THE ALLOTROPIC TRANSFORMATION. H. W. Worner. Australian J. Sci. Research 4, 62-83(1951) Mar.

A differential method for determining the thermoelectric power of titanium-platinum thermocouples is described. The results of the differential measurements are compared with data obtained in direct emf vs. temperature determinations. From the thermoelectric power results, the temperature dependency of the following properties has been deduced: (a) the Peltier coefficient of the titanium-platinum couple; (b) the difference between the Thomson coefficients of titanium and platinum; (c) the absolute thermoelectric power of titanium. It is shown that abrupt changes in thermoelectric properties accompany the α-β transformation in refined titanium, the transition temperature range being 883 ± 1 to 887 ± 2°C. In a commercial grade of titanium, the transformation occurs over the range 865 to 970°C. Some effects due to preferred orientation and the elimination thereof are also reported. (auth)

5672

THE MECHANISM AND RATE OF DISSOLUTION OF TITANIUM IN HYDROFLUORIC ACID. M. E. Straumanis and P. C. Chen. J. Electrochem. Soc., 98, 234-40(1951) June.

Titanium dissolves rapidly in HF according to the reaction $2Ti + 6HF \rightarrow 2TiF_3 + 3H_2$. The formation of the trifluoride was confirmed by titration with $KMnO_4$ solution and by measurement of the volume of H_2 evolved. The rate of dissolution, V, of Ti in HF of concentrations between 0.02N and 0.2N conforms with the empirical equation $V = 459\underline{N}^{2/3}$ mm³/cm²/min. For the acid between 0.2N and 10N the equation becomes $V = 88 + 473\underline{N}$ mm³/cm²/min. Metal salts added to the acid during the dissolution of Ti increased the rate in the following order: Fe^{+3}, Ni^{+2}, Ag^{+}, Cu^{+2}, Pt^{+4}, that is, nearly the order of decreasing overvoltage of the corresponding metals. Mg^{+2} proved to be inactive while Pb^{+2} hampered the dissolution reaction. The open-circuit potential of Ti became more anodic as the concentration of HF varied from 0.0125N to 0.2N. The potential remained practically constant with concentrations higher than 0.2N (−0.768 v, hydrogen scale). A visible grayish blue film was formed on Ti in concentrations below 0.5N. The dissolution of Ti in HF is probably an electrochemical process, based on the activity of local elements. (auth)

5673

MOLYBDENUM, A NEW HIGH-TEMPERATURE METAL. Robert M. Parke. Metal Progress 60, 81-96(1951) July.

A general discussion and review of Mo technology is given. Points covered in the discussion are source and availability, heat resistance, oxidation, fabrication, and alloys. 81 references.

5674

ZIRCONIUM PRODUCTION, PROPERTIES, AND ALLOYS. G. L. Miller. Metallurgia 43, 209-14, 220(1951) May.

After a brief review of the van Arkel and Kroll processes and a few comments on proposed improvements on these and other attempted methods for production of Zr metal, the author summarizes the properties of Zr and gives the results of systematic investigations of Zr alloys conducted by the U. S. Bureau of Mines and by Foote Mineral company. It was found that the Zr alloys with the best heat resistance at 1200°F have the poorest yield strength at this temperature, and it is doubtful if any of the alloys can be classified as satisfactory for service at 1200°F. The presence of 0.35% carbon in Zr did not produce any deleterious effects upon the tensile properties of hot-rolled sheet. The tensile and yield strengths, allowing for experimental errors, showed no change due to 0.1 to 8.2 % Hf and increased with rising O_2 and N_2 contents. The oxidation resistance of Zr is not improved much by alloying. 14 tables.

5675

PULSE-ANNEALING FOR THE STUDY OF RELAXATION PROCESSES IN SOLIDS. W. E. Parkins, G. J. Dienes, and F. W. Brown. J. Applied Phys. 22, 1012-19(1951) Aug.

A new experimental technique is presented for studying rate processes in solids. The method, termed "pulse-annealing," involves direct heating of a very small sample to a chosen annealing temperature for a short period, followed by rapid cooling to some fixed temperature for an in-place physical property measurement. The method is a very flexible one, as the foregoing cycle may be repeated to obtain any desired time-temperature history. General experimental techniques are described and specific application to graphite and metals noted.

The annealing process is examined theoretically. A method is described for deriving the activation energy of the fundamental relaxation process from the isothermal annealing curves of a physical property, the physical property being used as an index of the annealing process. It is shown that the activation energy is derivable without knowledge of the relation between the measured physical property and the fundamental kinetic variable. For further kinetic analysis (determination of rate constants and orders of reaction), however, it is necessary to know this relation. The analysis of isothermal and tempering experiments is compared. (auth)

5676

KINETICS OF ORDERING IN THE ALLOY AuCu. G. J. Dienes. J. Applied Phys. 22, 1020-6(1951) Aug.

The kinetics of ordering in AuCu has been studied using electrical resistivity as the index of order. A purely phenomenological analysis of isothermal resistivity-time curves showed that ordering in this alloy is a process characterized by a single constant activation energy of 29 kcal. For further kinetic analysis, it is necessary to transform the raw data into isothermal order parameter-time curves. This was accomplished via Muto's theoretical relation between resistivity and the Bragg-Williams order parameter, S. A consistent kinetic picture was obtained in terms of S, with the ordering process accurately described by a single third-order rate equation with all the kinetic constants fully evaluated. The usual ln (rate constant) vs. 1/T plot gave an acti-

vation energy of 28.5 kcal in excellent agreement with the phenomenological activation energy. Further experiments showed that the proposed kinetics predicts correctly the response to complex time temperature sequences. (auth)

5677

NOTES ON THE THERMOELECTRIC PROPERTIES OF BISMUTH. Takao Sato. J. Phys. Soc. Japan 6, 125-7 (1951) Mar.-Apr. (Short note)

Measurements have been made to determine the thermoelectric power of pure Bi and of a Bi alloy containing 0.2 at. % Sn for varied temperature differences. The value of the thermoelectric power is obtained from the thermoelectromotive force measured on a sample which is given a small temperature difference between its two ends. Graphs show the specific resistance as a function of temperature, thermoelectric power as a function of temperature difference between the two ends when one is maintained at 16°, 110°, and 217°C, and the temperature dependency of the thermoelectric power measured for a suitable temperature difference wherein the thermoelectric power does not change abruptly with temperature difference. It was found that the thermoelectric power of Bi depends on the temperature difference, though the reason for it is not clear.

5678

THE APPLICATION OF HYDROGEN EQUILIBRIUM-PRESSURE MEASUREMENTS TO THE INVESTIGATION OF TITANIUM ALLOY SYSTEMS. A. D. McQuillan. J. Inst. Metals 79, 73-88(1951) Apr.

A method is described for the investigation of equilibrium relations in certain alloy systems, which depends on the measurement of hydrogen pressures in equilibrium with a very dilute solution of hydrogen in the alloys. The method is illustrated by a theoretical treatment of a hypothetical, simplified system, and is then applied to a series of alloys in a limited region of the titanium–copper and titanium–iron systems. It is found that both copper and iron depress the $\alpha \rightleftharpoons \beta$ transformation in titanium. The effect of these addition elements on the solubility of hydrogen in the titanium-rich β solid solution has been examined. (auth)

5679

A THEORY OF THE α, α' PHASES IN THE Al-Zn SYSTEM. R. S. Leigh. Phil. Mag, 42, 876-82(1951) Aug.

In the binary alloys of Al-Zn there exists, above a certain temperature, a mixed crystal region in which the two phases α and α' both have the same face-centered cubic structure but with different compositions and lattice spacings. It is shown that an explanation for the formation of these phase boundaries is provided by the electronic theory of the elastic properties of single crystals of aluminium. A maximum in one of the shear constants at an electron concentration corresponding to the $\alpha + \alpha'$ region gives rise to a subsidiary maximum in the temperature-dependent part of the free energy, which leads, according to the usual construction, to a mixed phase region. (auth)

5680

A METHOD FOR ANNEALING METAL POWDERS WITHOUT SINTERING. F. W. Von Batchelder and H. E. Stauss. Rev. Sci. Instruments 22, 396-7(1951) June.

A method is described for maintaining the separation of the component particles during the annealing of a metallic powder. The technique consists of mixing the metal powder with a larger quantity of a second powder that is inactive chemically relative to the metal, annealing the mixed powders, and separating the metal by dissolving the inert powder after annealing. In this way gold, silver, and iron powders have been annealed in sodium chloride without sintering. (auth)

5681

MEASUREMENT OF CARBON DIFFUSION IN METALLIC CARBIDES. G. C. Duczynski and R. Landauer. J. Applied Phys. 22, 952-5(1951) July.

A method for measuring the diffusion coefficient of carbon in metallic carbides is proposed. The rate at which excess metallic inclusions are consumed by carbon diffusing in from a surface is used to indicate the extent to which diffusion has taken place. Conditions are derived under which the results are susceptible to simple analytic treatment. (auth)

MINERALS AND MINERALOGY

5682

Geological Survey

ABSTRACTS OF THE LITERATURE ON SYNTHESIS OF APATITES AND SOME RELATED PHOSPHATES; PART I; Elizabeth B. Jaffe. Dec. 1950. 72p. plates. (TEI-132(pt.1))

Approximately 45 detailed abstracts of selected papers on synthesis of apatites and related phosphates are presented. Syntheses attempted by various workers are summarized in three tables. A brief discussion of problems encountered and various general approaches to their solution is included.

5683

Geological Survey

DISTRIBUTION OF URANIUM IN RICH PHOSPHATE BEDS OF THE PHOSPHORIA FORMATION; by M. E. Thompson. Feb. 1951. 36p. (TEI-142)

Samples were collected from Trail Canyon and Reservoir Mountain in Caribou County, Idaho, Coal Canyon in Lincoln County, Wyo., and Brazer Canyon in Rich County, Utah. Five sets of samples were analyzed radiometrically for U, and chemically for P_2O_5, CaO, organic matter, and loss on ignition. A Rosiwal analysis was made of thin sections of one set of samples. The results of the analyses are plotted on graphs and on scatter diagrams, and coefficients of correlation are given for U with CaO, P_2O_5, organic matter, and loss on ignition. Preliminary studies seem to indicate that the concentration of U in these samples of phosphate rock is not due wholly to phosphate content, but may depend in part on organic matter or on other components. The correlations of U with P_2O_5 are poor in the groups of samples with smaller amounts of U but are good in the groups of samples containing more U. (auth)

5684

Carbide and Carbon Chemicals Corp., Y-12

STUDIES OF RECOVERY PROCESSES FOR WESTERN URANIUM BEARING ORES; PART I. A CRITICAL EXAMINATION OF THE SALT-ROAST, ACID-LEACH PROCESS FOR WESTERN URANIUM ORES; PART II. DIRECT ACID LEACHING OF WESTERN URANIUM ORES; by V. L. Saine and K. B. Brown. Oct. 14, 1949. Decl. Sept. 19, 1951. 129p. (AECD-3241; Y-499)

The investigation of the "acid process" as applied to various carnotite and roscoelite ores has been completed. The reactions of these ores to the process have been considered from the standpoint of the percentages of U and V recovered, the quantities of HCl produced, and the amounts of HCl consumed. Optimum conditions have been determined, and those ores to which the process may be applied with proficiency are recognized. The roasting and leaching steps in the process are not exceedingly critical, the factor imposing the major limitation on the process being the concentration of CaO which may be tolerated in the feed material. To attain optimum recoveries and a production of acid equivalent to the amount used, the CaO content should be limited to a concentration of about 2.5%. With some modification of the process (sulfate roasting) and with some increase in processing costs, it may be possible to process

ores of somewhat higher lime content. With marked improvements in the process for recovering U from the acid liquors, it is more than probable that a direct acid leach process would be satisfactory for the treatment of low-lime U ores in which the V level is not high enough to justify recovery and for some ores containing U in a form (other than carnotite) soluble in acids but insoluble in carbonate solutions. Since autunite deposits contain only small amounts of "impurity" minerals (such as minerals of Fe and Ca), it is probable that a fairly simple "acid method" could be worked out for their treatment.

5685

Arizona Bureau of Mines, Univ. of Arizona
RADIOACTIVE URANIUM AND THORIUM; John W. Anthony, comp. June 1948. 22p. (NP-3116)

5686

Carbide and Carbon Chemicals Corp., Y-12
STUDIES OF RECOVERY PROCESSES FOR WESTERN URANIUM BEARING ORES; III. THE RECOVERY OF URANIUM AND VANADIUM FROM ACID LEACH LIQUORS OF CARNOTITE ORES; by C. F. Coleman. Nov. 25, 1949. Decl. Sept. 19, 1951. 44p. (AECD-3238; Y-500)

An investigation of U and V solution chemistry has been conducted primarily to develop improvements in or a replacement for the present recovery process, which is based on a hydrolytic precipitation of U and V together with other constituents. The conditions for the reduction, green-sludge precipitation, and Fe vanadate precipitation steps of present processes were examined. Modifications were considered, expecially one using a caustic wash after hydrolytic precipitation. Separation of Al was good and of Fe fair, but V separation was poor. Precipitation of uranyl arsenate or arsenite showed no real advantage over hydrolytic precipitation. Precipitation of U peroxide was completely unsuccessful, even after removal of most of the V. Precipitation of uranous fluoride or oxalate showed some advantages, which were outweighed by high reagent consumption. Precipitation of uranous p-toluenesulfinate appeared nearly as successful as precipitation of uranous phosphate, and may eventually prove better. Only fair results were obtained in the precipitation of ferric vanadate from weakly acid solutions. Ferrous vanadate could not be precipitated at pH 3 or below because of reduction of the vanadate. Pb vanadate showed no advantage under the same conditions. No precipitate of Ca vanadate was obtained below pH 6.

5687

MECHANICALLY-TREATED NONMETALS INVESTIGATED WITH THE AID OF END-WINDOW GEIGER COUNTERS. J. Kramer. Z. Physik 128, 538-45(1950) Nov. 16. (In German)

As is known, exothermal processes in metals, such as recrystallizations or rest phenomena, are often accompanied by emissions of electrons which are revealed by the counter. The author observed similar, usually very short-lived, responses of the end-window counter to the mechanical crushing of a number of crystalline nonmetals, e.g., feldspar, quartz pyrite, zinc sulfide, corundum, lepidolite, and others. It had not yet been possible to ascertain whether an emission of electrons took place; the effect was caused perhaps by a field due to a piezoelectric phenomenon and influencing the filament point of the counter. Electron emissions of that kind may play their part in the origin of the silicosis of the lungs, caused by the inhalation of dusts.

5688

THE URANIUM DEPOSITS NEAR MARYSVALE, PIUTE COUNTY, UTAH. John W. Gruner, Wallace G. Fetzer, and Irving Rapaport. Econ. Geol. 46, 243-51(1951) May.

The uranium deposits are ore zones in igneous rocks chiefly in an intrusive of quartz monzonite. The zones consist of quartz-fluorite-calcite-pyrite veins and veinlets commonly of similar strike and dip. Pitchblende occurs as very thin seams or as grains in and between the veins. Weathering extends to at least 200 ft and has resulted in secondary schroeckingerite, autunite, torbernite (and their meta modifications) and a uranophane-like mineral. The mineralization is of late Tertiary age. (auth)

5689

STUDIES OF RADIOACTIVE COMPOUNDS: II—METAZEUNERITE, URANOPHANE, KASOLITE, AND CUPROSKLODOWSKITE IN CANADA. D. D. Hogarth. Am. Mineral. 36, 411-14(1951) May-June.

Four rare U minerals identified in the Nicholson Mines, Ltd., region, Saskatchewan, their mode of occurrence in the vein, and the geological environment of the vein are reported on briefly.

5690

A METHOD FOR DETERMINING URANIUM AND THORIUM IN ROCKS BY THE NUCLEAR PHOTOGRAPHIC PLATE. J. W. Bremner. Proc. Phys. Soc. (London) 64A, 25-31 (1951) Jan.

A nuclear photographic emulsion which has been in contact with material containing traces of U and Th shows on processing α-ray stars arising from atoms which have undergone several successive disintegrations during the exposure. The relative frequency of the various multiple stars, which depends on the U/Th ratio, is evaluated on simple assumptions to show the possibility of determining these elements by star counting. (auth)

5691

THE USE OF SENSITIVE GAMMA RAY DETECTORS IN PROSPECTING. William L. Russell and S. A. Scherbatskoy. Econ. Geol. 46, 427-46(1951) June-July.

This paper describes the types of instruments needed in searching for radioactive ores and the various corrections that must be applied to make the instrumental readings useful. The most important factor in interpreting the results of gamma ray surveys is the recognition of anomalies. An anomaly of this type may be defined as radiation unexpectedly large for the associated field conditions. A knowledge of the characteristic radiation intensities associated with different rock types is an aid in the recognition of anomalies. The characteristic radiation intensities of a number of rock types are given in the paper. It is important to consider the effect of rock type, field conditions, weathering and climate in interpreting anomalies. The highly radioactive igneous rocks of the Front Range of the Rocky Mountains in Colorado may be the source of the uranium in the ore deposits farther west. (auth)

PHYSICS

5692
Oak Ridge National Lab.
INSTRUMENT RESEARCH AND DEVELOPMENT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JANUARY 20, 1951. W. E. Thompson, comp. June 25, 1951. 26p. (ORNL-1021)

A differential and integral pulse-height selector for use with the A-1 amplifier has been built. The circuit of this pulse-height selector is described in some detail. In energy measurements with proportional counters it is essential that ionizing events with equal energies should give rise to identical voltage pulses, regardless of location of the ionizing event within the active volume of the chamber. This means that the gas multiplication, and hence the electric field, must be constant for the entire length of the collection wire. Methods have been investigated for achieving this in the case of the usual cylindrical counter. The construction and operation of a constant water monitor is discussed briefly. A magnetic-induction flowmeter is described briefly. The flowmeter has been applied to the measurement of a 40 cc/min flow to within ±5%. The performance of a β-γ background monitor, Q1112, employing a 5819 photomultiplier tube and an anthracene crystal as the detector is summarized. This monitor contains a nonoverload amplifier that permits monitoring low-energy γ rays (50 kev) without overloading on the high energies. A linear count-rate meter covers the ranges from 2000 cpm maximum to 100,000 cpm maximum in four steps and drives a 1-ma Esterline-Angus recorder. An additional range of 500 cpm maximum can be supplied. A description is given of the Automatic Titrator, Model Q-945, designed to provide a fast, precise chemical titration by giving a fast reagent-feed rate when the electrode potential remains constant and an intermittent feed when the electrode potential is changing.

5693
Brookhaven National Lab.
RELATIVE INTERNAL CONVERSION IN THE L SUB-SHELLS. J. W. Mihelich and E. L. Church. Aug. 15, 1951. 2p. (AECU-1604)

The report is reproduced here in its entirety.

An experimental survey is being made of the relative intensity of L_I, L_{II}, and L_{III} conversion lines of certain low-energy γ-rays originating in nuclei of medium atomic number. Data have been obtained for the following multipole orders: M1, M1 + E2, E2, and M4. Semicircular photographic spectrographs are being employed.

When multipole order assignments are taken from Goldhaber and Sunyar (Phys. Rev., in press), the results can be summarized as follows: (1) M1 transitions are L converted in the L_I shell predominantly. This is in accord with the observations that experimental K/L_{total} ratios for magnetic dipole transitions are not in disagreement with the ratio of the following theoretical values: the K-shell conversion coefficients of Reitz (Phys. Rev. 77, 10(1950)) and the L_I shell coefficients of Gellman, Griffith, and Stanley (Phys. Rev. 80, 866(1950)). (2) E2 transitions are L converted in the L_{II} and L_{III} shells primarily, L_I conversion being appreciably less. (3) It seems that relative mixtures of M1 and E2 may be determinable from L_{II}/L_I or L_{III}/L_I ratios. (4) M4 transitions are L converted in primarily the L_I and L_{III} shells. This trend with increasing magnetic multipole order is in agreement with the approximate theory of Tralli and Lowen (Phys. Rev. 76, 1541(1949)).

5694
Carbide and Carbon Chemicals Co., Y-12 Area
DIFFUSION OF GASES AND LIQUIDS IN SOLIDS. Frances L. Sachs. July 23, 1951. 13p. (Y-B4-21)

This bibliography contains 32 references to papers on diffusion of gases and liquids in solids selected from Chemical Abstracts, 1936-1949; Nuclear Science Abstracts; and the Y-12 catalog. A brief abstract is given for each title.

5695
Pittsburgh Univ.
THE HEAT CAPACITY OF CADMIUM BETWEEN 12°K AND 300°K AND THE ENTROPY OF CADMIUM AT 25°C; PROGRESS REPORT FOR APRIL 1, 1951–JULY 1, 1951. R. S. Craig and E. A. Bates. July 9, 1951. 4p. (NYO-944)

The constant pressure heat capacity for Cd is reported for temperatures ranging from 12 to 300°K. Values for the constant volume heat capacity and the Debye characteristic temperature are also reported for selected temperatures between 12 and 300°K. The entropy of Cd at 25°C was found to be 12.378 cal/mole degree. (auth)

5696
Columbia Univ.
PROGRESS REPORT; NUCLEAR PHYSICS LABORATORIES. J. R. Dunning, Director. Mar. 31, 1951. 43p. (CU-94; DR-1661)

The total neutron cross section of Mo has been investigated with the slow-neutron spectrometer. The resonances of Br, Mn, Zn, Th, Cr, Al, and Ga have been determined in the epithermal region. Plots show the slow-neutron transmission of these elements. The slow-neutron-velocity spectrometer power-supply control circuit has been modified to interlock the positive supplies with the bias voltage. A transmission run has been made on a sample of normal isotopic Te over the energy range 0.06 to 0.50 ev. A value of 3.8 ± 0.2 barn was found for the free scattering cross section of Te. An enriched sample of Te^{123} was studied by means of transmission runs in the region 0.75 to 3.30 ev. Resonances are indicated at approximately 2.2, 1.7, 1.4, 1.2, 1.1, 0.9, and below 0.8 ev. Neutron capture resonances in Ag, Cd, and BaO have been studied by means of the emitted γ radiation. Values of σ_s/σ_t and Γ_n/Γ have been found for the resonances of Ag by means of the scattering apparatus. The neutron transmission of FeF_3 has been determined with the use of the Brookhaven slow chopper and the Columbia neutron velocity selector. A preliminary analysis indicates that FeF_3 has a paramagnetic cross section of 16 barns at 12 A. Absorption spectra of high purity and technical grade xylene were taken on a Cary recording spectrophotometer. No absorption peaks were found in the region of 3000 to 4500 A. Tentative values for the relative light output per unit energy loss for various organic phosphors are as follows: anthracene, 1.0; t-stilbene, 0.73; diphenylacetylene, ~0.6; p-terphenyl, 0.33. The rise time of a diphenylacetylene crystal is $\sim 0.6 \times 10^{-8}$ sec. Work has been carried out on the mechanism of the Szilard-Chalmers reaction on triphenylarsine. The nonextractable organic layer has been shown to contain a number of different activities. γ-ray-spectra curves of Co^{60} and a Cs^{137}-Na^{22} mixture are shown from a setup which represents a compromise among the various factors influencing the resolution of scintillation spectrometers. Experiments have been carried to determine the optimum thickness of ZnS phosphor layers for the most efficient detection of α particles and to detect α particles

from slow neutron capture by B. The diagram of the inductive extinguishing circuit applicable to nonself-quenching Geiger tubes is shown. A fast unbalanced bridge type coincidence circuit which has a resolution curve with a half width at half maximum of 3×10^{-9} sec and a detection efficiency greater than 80% has been developed and is described. The Sb^{124} contribution to the Sb^{122} coincidence spectrum has been measured. Sb^{122} has the allowed shape from its endpoint of 1450 kev down to about 250 kev. The Z-dependent formulas of Uhlenbeck and Lennox have been applied to the interpretation of the β-γ angular correlation in Sb^{122}. An analysis of the level scheme, utilizing both the angular correlation and the coincidence spectrometer results, indicates that tensor interaction is involved. A relation is given allowing calculation of electron-recoil nucleus angular correlation curves for purposes of comparison with experimental data. Investigation of the γ-ray spectrum of F^{17} indicates the presence of a γ ray of energy $> mc^2$ and about 30 sec half life. This has been attributed to O^{19} formed by $O^{18}(d,p)O^{19}$.

5697

THE MEASUREMENT OF e/M BY CYCLOTRON RESONANCE. H. Sommer, H. A. Thomas, and J. A. Hipple. Phys. Rev. 82, 697-702(1951) June 1.

The cyclotron resonance frequency of the proton has been measured using a new method. By measuring the spin precessional frequency of the proton in the same magnetic field, the proton magnetic moment in nuclear magnetons has been determined as $\mu_p = 2.79276 \pm 0.00006$. In combination with other data this result can be used directly to determine the charge-to-mass ratio of the proton $e/M_p = 9579.4_2 \pm 0.3$ emu/g, the faraday $F = 9652.0_3 \pm 0.3$ emu/g (physical scale), and the ratio of the proton mass to the electron mass $M_p/m_e = 1836.12 \pm 0.05$. A preliminary value for the H_2–D doublet is given. (auth)

5698

MAGNET CURRENT STABILIZER. H. S. Sommers, Jr., P. R. Weiss, and W. Halpern. Rev. Sci. Instruments 22, 612-18(1951) Aug.

The design and performance of a feedback amplifier for the precision control of the current through a 40-kw magnet is described. The system uses the difference between the IR drop in a standard resistor and a preset potentiometer voltage to control the current. The principal components are a high gain vibrator amplifier and a stabilized power amplifier incorporating a commercial motor-generator set. Current fluctuations are kept below one part in a million. (auth)

5699

AN INTERNATIONAL BIBLIOGRAPHY ON ATOMIC ENERGY, VOL. II, SCIENTIFIC ASPECTS. Atomic Energy Commission Group, Department of Security Council Affairs, United Nations. New York, Columbia University Press, 1951.

The titles of 24,282 articles on atomic energy are listed alphabetically according to authors within the following five major sections: fundamental nuclear science, biological and medical effects of high-energy radiations, isotopes in biology and medicine, and applications of radioactive tracers in nonbiological sciences and technology.

5700

CAPSULES FOR NEUTRON IRRADIATION OF SMALL QUANTITIES OF MATERIAL. J. V. P. Long. J. Sci. Instruments 28, 191(1951) June. (Laboratory and Workshop Notes)

A method for pile irradiation of small quantities (1 mg to ~1 g) of dry powders in a capsule of graphite with a graphite plug is discussed briefly.

ASTROPHYSICS

5701

Ames Lab.

TRANSITION PROBABILITIES FOR C_2 AND N_2^+. (Contribution No. 144). Harrison Shull. July 10, 1951. 2p. (AECU-1476)

The report is reproduced here in its entirety.

In a previous paper (Astrophys. J. 112, 352 (1950)), the author reported the results of semitheoretical calculations of transition probabilities for C_2 and N_2^+. These calculations were made using the ordinary dipole length form of the dipole transition operator. Following the suggestion of Professor Chandrasekhar, the calculations have been repeated using the dipole velocity form of the transition operator but with the same approximate methods and orbitals as before. (See Astrophys. J. 102, 223, 395 (1945); 108, 354 (1948) for applications of the dipole velocity method in the case of atoms).

The dipole velocity calculations showed a remarkably different dependence upon the assumed degree of s-p hybridization in the orbitals concerned from that shown by the dipole length calculations. For a given choice of the effective nuclear charges, the two methods agree in a very limited region of hybridization. Hence by making a reasonable choice for the effective Z values, one can obtain an estimate of hybridization completely independent of the semiempirical choice kindly supplied by Professor Mulliken in the previous calculations.

The 'best' choice of hybridizations is somewhat higher than that suggested by Professor Mulliken, and leads to the following 'best' choices for f numbers:

C_2, Swan bands, $^3\pi_g - {}^3\pi_u$, f = 0.18

C_2, Deslandres, D'Azambuja system, $^1\pi_g - {}^1\pi_u$, f = 0.24

N_2^+, 1st negative system, $^2\Sigma_u^+ - {}^2\Sigma_g^+$, f = 0.18.

It will be noted that these values are about 40 per cent higher than those previously suggested by the author and roughly 75 times those suggested by Lyddane, Rogers, and Roach (Phys. Rev. 60, 281 (1941)).

The net effect of these results is to reduce considerably the estimates of C_2 (and possible CN) concentrations wherever these are based upon absolute intensity measurements of these transitions. Complete details of these calculations will be published elsewhere.

COSMIC RADIATION

5702

Rochester Univ.

THE ENERGY SPECTRUM OF PRIMARY COSMIC RADIATION. M. F. Kaplon, B. Peters, H. L. Reynolds, and D. M. Ritson. Aug. 1951. 49p. (NYO-904)

Techniques have been developed by which the energy spectrum of heavy primary nuclei can be measured in the energy range of 10^9 to 10^{11} ev/nucleon and of all components of the primary radiation in the energy range from 10^{11} to 10^{14} ev/nucleon. It is shown that even the heaviest nuclei in the primary radiation ($Z \sim 26$) have lost their orbital electrons before entering the atmosphere which supports the assumption that they do not proceed from the solar corona directly to the earth. It is also shown that the velocity spectrum of all primaries of charge $Z > 1$ is independent of the mass of the nuclei and that it differs only slightly from that of the proton component in the energy interval between 3×10^8 and 10^{10} ev/nucleon. (auth)

5703

CORRELATION OF AURORAS WITH INCREASED COSMIC RAY INTENSITIES (NOVEMBER 19, 1949). N. C. Gerson. Nature 167, 894-5(1951) June 2. (Letter to the editor)

A correlation has been found between the intense burst of solar radiation, auroras, and increased cosmic-ray activity observed on Nov. 19, 1949. Summaries are given of reports of cosmic-ray activity and of sudden ionospheric disturbances observed in different parts of the world. The author speculates that the solar particles ejected during the flare had a velocity distribution such that high-energy particles of velocity $\sim 1 \times 10^{10}$ cm/sec were responsible for the increase in cosmic-ray intensity, while low-energy particles of speed $\sim 2.5 \times 10^{8}$ to 3.1×10^{8} cm/sec caused the aurora. The aurora observed in New Zealand on the same day is given possible explanations. Reasons are given for concluding that the cosmic-ray particles were charged.

5704

ABSORPTION OF COSMIC RAYS IN LEAD. G. R. Heyland and W. E. Duncanson. Nature 167, 895-6(1951) June 2. (Letter to the editor)

The absorption curve for the vertical component of cosmic rays in Pb has been investigated with a set of G-M counter telescopes of square cross section. Seven trays of counters were employed, determining five points on the curve with approximately the same accuracy. The relative probable error between neighboring points is about 0.2%. By varying the experimental conditions it was shown that the shape of the absorption curve is independent of the position of the absorber, i.e., whether it is wholly above or wholly within the telescope. It is concluded that the absorption curve for Pb (0 to 30 cm) for an incident cosmic ray beam of constant intensity and energy spectrum decreases monotonically with increasing absorber thickness.

5705

ON A PENETRATING COMPONENT OF THE SECONDARY RADIATION OF ORDINARY MESONS. Roland Maze. Compt. rend. 232, 2421-3(1951) June 25. (In French)

Apart from a semipenetrating and diverging photonic component described elsewhere (Compt. rend. 231, 1477 (1950)), radiation generated in matter by ordinary cosmic mesons contains a penetrating component which was revealed by comparing aboveground and underground measurements with a telescopic arrangement of two counter groups separated by a Pb filter of variable thickness. The radiation produced in a Pb mass above the telescope seems to consist of mesons formed from photons generated in matter under the impact of cosmic mesons. A mechanism of production of photomesons similar to that occurring in the Berkeley experiments appears to be at work in nature.

5706

SOLAR ACTIVITY AND COSMIC RADIATION. E. G. von Roka. Z. Naturforsch. 6a, 117-22(1951) Mar. (In German)

With the statistical method of overlapping selected days (Chree, Proc. Roy. Soc. (London) 101A, 368(1922) applied to daily averages of the relative numbers of sun spots and cosmic-ray intensities, a possible correlation was sought between the two phenomena. The known 27-day wave of the cosmic radiation lags with a 4- to 6-day phase difference behind the wave of the solar activity; thus represented, the two variations stand in a very good negative correlation to each other. A parallel relationship would have supported the assumption of a constant presence of a solar component in the cosmic radiation; the results reported reject this hypothesis. (auth)

5707

ENERGY SPECTRUM OF THE PRIMARY COMPONENT OF COSMIC RAYS. Ya. P. Terletskiĭ and A. A. Logunov. Zhur. Eksptl'. i Teoret. Fiz. 21, 567-8(1951) Apr. (Letter to editor; in Russian)

Fermi sees in collisions between ions and moving magnetized clouds of interstellar matter the mechanism that accelerates primary cosmic particles (protons and other ions). However, owing to ionization losses, only ions whose initial energy exceeds certain threshold values, depending on the ions' atomic numbers, can thus be accelerated; it follows that another accelerating mechanism, probably involving magnetic fields of individual stars, must furnish the threshold energies. It is shown that these threshold values are high, reaching the order of magnitude of the mean energy of the cosmic primaries, and that the role of the Fermi mechanism is essentially that of a redistributor of energies. An attempt is made to calculate the corresponding distribution function.

5708

ORIGIN OF COSMIC RAYS. Ya P. Terletskiĭ. Uspekhi Fiz. Nauk 44, 46-69(1951) May. (In Russian)

In a synthetic view on recent hypotheses of the origin of cosmic rays, the primary source of energy of this radiation is sought in interstellar nuclear transformations which furnish the energy (1) to grand-scale eruptions by the stars of ionized matter of high electric conductivity and, thus, (2) to magnetic fields both around the star itself and around interstellar clouds that form from the erupted material; these fields act as inductive accelerators on some of the particles of the ejected matter, first while the particles are still within the rotating or pulsating magnetic field of the parent star, then during multiple collisions with wandering interstellar clouds. The primary component of the cosmic radiation is thus formed in a two-step acceleration process. The main accumulation of energy takes place during the first, stellar, phase, whereas the second (Fermi's) mechanism serves chiefly for the spacial homogenization of the radiation and for its redistribution according to the final energy spectrum. The author was among the first to point to stellar magnetic fields as probable accelerators of cosmic particles (Doklady Acad. Nauk S.S.S.R. 47, 104 (1945); Zhur. Eksptl'. i Teoret. Fiz. 16, 463(1946)); he also foresaw the presence of heavy ions in the primary component (Vestnik Mosk. Univ., 75(1948)).

5709

THE PROTON COMPONENT OF THE COSMIC RADIATION AT SEA LEVEL. E. L. Goldwasser and T. C. Merkle, Jr. Phys. Rev. 83, 43-6(1951) July 1.

The range spectra of mesons and protons in the sea-level cosmic radiation have been investigated with a cloud chamber that had within its volume a total of 10 cm, of lead equivalent absorbing material. Measurements were made with absorbers equivalent to 2, 7, 17, and 48 cm of lead above the apparatus. The masses of stopping particles were determined by observing the momentum and range of each particle. One hundred and sixty-one mesons (mass = $205 \pm 2m_e$) and 72 protons (mass = $1900 \pm 44m_e$) were observed. No evidence was found for the existence of any particles with intermediate mass. Data obtained under each of the four thicknesses of moderating absorber were used to give four points on the differential range spectra for mesons and protons. The meson spectrum has a peak occurring in the range between 17 and 30 cm of lead. The observed proton component can be interpreted either as the residual of a flux of protons which is incident on top of the moderator and degraded in energy with passage through the moderator, or as a flux of protons produced in the moderator by an incident neutral radiation, probably neutrons. The proton range spectrum fits an exponential absorption law with a mean free path of 12 cm of lead. This is just the order of attenuation to be expected from nuclear interactions of protons or neutrons. Thus, if the protons are incident on the moderator, their differential range spectrum would have to have been flat in the region between 8 and 54 cm range in lead. This implication, together with the behavior of the proton component in the lead absorber plates

observed in the cloud chamber, points to the incident neutron hypothesis as the more probable explanation of the observed protons. (auth)

5710

CLOUD-CHAMBER ANALYSIS OF STOPPED PARTICLES IN THE SEA-LEVEL COSMIC RADIATION. G. M. Nonnemaker and J. C. Street. Phys. Rev. 82, 564-5(1951) May 15. (Letter to the editor)

A Wilson cloud chamber beneath a filter of 119 g/cm² of Pb plus 21 g/cm² of Pb equivalent and above an absorber of 81 g/cm² of Pb plus 7 g/cm² of Pb equivalent was expanded by anticoincidence arrangement which selected particles stopping in the absorber. A total of 348 pictures were taken at an average rate of 0.0159 cpm. Of these, 227 were μ mesons; 10 were dense tracks with momenta greater than 250 Mev/c; 23 were energetic particles which failed to trigger the anticoincidence tray beneath the absorber; 15 were single electrons with momenta less than 70 Mev/c; and 73 were other electronic events such as showers and knock-on processes which triggered the proper sequence of counters. The absolute intensity of mesons stopping within the differential range interval of this experiment was found to be $(3.26 \pm 0.23) \times 10^{-6}$/g sec sterad (air-equivalent) for mesons with a range of 115 g/cm² (air-equivalent). The ratio of positive to negative mesons stopping in the absorber was 0.94 ± 0.07. The upper cutoff in momentum as determined from this distribution gave a meson mass of 220 ± 12 m_e.

5711

THE IONIZATION OF COSMIC-RAY PARTICLES. P. Goodman, K. P. Nicholson, and H. D. Rathgeber. Proc. Phys. Soc. (London) 64A, 96-7(1951) Jan. (Letter to the editor)

After a brief introduction concerning contradictions between theory and observations of other workers on cosmic-ray-produced ionization in photographic emulsions, the authors give preliminary results of experiments on specific ionization as measured with a proportional counter. The proportional counter, filled to a pressure of 86 cm Hg with a mixture of A and 6% ethylene, was inserted in the cosmic-ray spectrometer briefly described elsewhere (Caro et al., Nature 165, 688(1950)), between the G-M counter tray immediately above the magnet and the magnet itself. While the measurements on electrons agree with the theory of Halpern and Hall (Phys. Rev. 73, 477(1948)), those on heavy cosmic-ray particles do not. Possible causes for the difference are considered, and it is concluded that μ mesons differ from electrons in some respect other than mass.

5712

THE MOMENTUM SPECTRUM AND POSITIVE EXCESS OF COSMIC RAY MESONS AT SEA-LEVEL. D. E. Caro, J. K. Parry, and H. D. Rathgeber. Australian J. Sci. Research 4, 16-35(1951) March.

A spectrometer for momentum measurements on cosmic ray particles is described. Charged cosmic ray particles are deflected in the air gap of an electromagnet and the deflection is recorded by an array of G-M counters. The momentum distribution and positive excess of particles which penetrate 10 cm of lead is determined over a momentum range 2.4×10^8 ev /c to 5×10^{10} ev /c from measurements on 6056 particles. (auth)

5713

TEMPERATURE OF THE UPPER ATMOSPHERE AND MESON PRODUCTION. A. Duperier. Nature 167, 312-13 (1951) Feb. 24. (Letter to the editor)

By means of a triple-coincidence counter arrangement with a lead absorber similar to that used in a previous experiment (Proc. Phys. Soc. 62A, 684 (1949); NSA 4-482) measurements have been made which indicate the correlation between meson intensity at sea level and the temperature of the air layer limited by the 200- and 50-mb isobars.

5714

CLOUD-CHAMBER OBSERVATIONS OF THE NEUTRAL V-PARTICLE DISINTEGRATION. R. W. Thompson, Hans O. Cohn, and R. S. Flum. Phys. Rev. 83, 175(1951) July 1. (Letter to the editor)

In a sea-level, magnet cloud-chamber experiment on penetrating showers, now in progress, nine examples of the V^0-particle disintegration process have been observed. In two of the V^0-particle photographs, the positive particle is identified as a proton. The momentum of the positive and negative particles in two cases suggests a V^0 mass of ~2165 ± 20 m_e. Three of the events are discussed, and two photographs are shown.

5715

HIGH ALTITUDE MEASUREMENTS OF THE PENETRATING COMPONENT INTENSITY OF COSMIC RADIATION NEAR THE GEOMAGNETIC EQUATOR. A. S. Rao, V. K. Balasubrahmanyam, G. S. Gokhale, and A. W. Pereira. Phys. Rev. 83, 173(1951) July 1. (Letter to the editor)

The vertical intensity of cosmic radiation penetrating 10 cm of lead absorber at high altitudes was measured near the geomagnetic equator (Bangalore 3°N mag.) in free-balloon ascents during 1950-1951. Quadruple coincidences, together with atmospheric pressure and temperature inside the gondola, were transmitted continuously over a single ultra-high-frequency radio carrier to the ground receiving apparatus which recorded the information automatically on a moving paper tape. A composite curve of six good flights made at Bangalore is given. The vertical intensity of cosmic radiation penetrating 10 cm of lead absorber rises continuously down to a pressure of ~120 millibars and then falls gradually down to the lowest pressures reached by the apparatus.

5716

CONTRIBUTION TO THE STUDY OF PENETRATING SHOWERS. H. A. Meyer, G. Schwachheim, and A. Wataghin. Anais acad. brasil. cienc. 23, 61-72(1951) Mar. 31. (In Portuguese)

Penetrating atmospheric showers were observed with the aid of parallel telescopic setups demonstrating the small angular dispersion of the showers and their μ-mesonic nature. Showers generated in carbon (or gasoline) filters above the telescopic setup were characteristically less penetrating.

5717

MESON PRODUCTION IN THE ATMOSPHERE. J. D. Pullar and E. G. Dymond. Phil. Mag. 42, 663-4(1951) June. (Correspondence)

The variation with altitude of the vertical intensity of the penetrating component of cosmic radiation has been measured in a series of balloon flights from Edinburgh, geomagnetic latitude 59°N. A telescope of three counters with 8 cm of Pb absorber was used. The influence of electron showers coming in from the side was measured and subtracted from the counting rates. The true vertical penetrating flux then shows a maximum at 35 mb, representing the production of mesons by particles of the primary beam.

5718

COSMIC RAYS AS A POSSIBLE SOURCE OF GALACTIC RADIOFREQUENCY RADIATIONS. V. L. Ginsburg. Doklady Akad. Nauk S.S.S.R. 76, 377-80(1951). (In Russian)

Recent work has shown the inadequacy of the explanation of the galactic r-f radiation as due to thermal radiations emanating from interstellar electrons. Another hypothesis is examined which sees the galactic radiation as a bremsstrahlung from relativistic electron component of cosmic

rays in interaction with interstellar and stellar magnetic fields. An analysis of known facts and of the principal assumptions shows that the hypothesis involving interstellar fields probably is capable of accounting for the intensity of the galactic r-f radiation, whereas that involving discrete stellar fields presents certain difficulties. The question also is discussed of the possibility of observing similar phenomena in the earth's magnetic field; although generally very weak, the effect could perhaps explain certain features of the radiation accompanying the aurora polaris.

5719

ON THE FLUCTUATION OF A NUCLEON CASCADE IN HOMOGENEOUS NUCLEAR MATTER AND CALCULATION OF AVERAGE NUMBERS. PART I. H. Messel. Proc. Roy. Irish Acad. 54A, 125-35(1951) Feb.

The first and second moments of the nucleon cascade in homogeneous nuclear matter are evaluated. It is found that the results are very similar to those previously obtained for the electron-photon cascade (Janossy and Messel, Proc. Phys. Soc. (London) 63A, 1101(1950)), i.e., the fluctuation at the cascade maximum is that expected for a Poisson distribution, but deviates greatly from this on either side of the maximum. (auth)

5720

A CLOUD-CHAMBER STUDY OF THE NEW UNSTABLE PARTICLES. H. S. Bridge and M. Annis. Phys. Rev. 82, 445-6(1951) May 1. (Letter to the editor)

In a set of pictures taken with a large multiplate cloud chamber at 700 g/cm² atmospheric depth, 10 examples of tracks that deviate suddenly in the gas of the chamber were observed. These are similar to the "V" tracks reported by various authors. A partial analysis of these tracks is made.

5721

EXPERIMENTS ON LARGE COSMIC-RAY BURSTS UNDER THICK ABSORBERS AT 11,500-FEET ELEVATION. Thomas G. Stinchcomb. Phys. Rev. 83, 422-31(1951) July 15.

Using a Carnegie Model "C" ionization chamber together with Geiger-Mueller tube coincidence circuits, the nature of the radiation which produces large bursts (greater than 200 particles) of cosmic rays under thick absorbers at 11,500 ft elevation has been investigated at Climax, Colorado. The percentage of this radiation which was accompanied by air showers was determined and found to be dependent upon the burst size. The absorption mean free paths for the burst-producing radiation (excluding bursts produced by μ mesons and by air showers) were measured in lead and iron and found to be 350 ± 40 g/cm² in lead and 240 ± 20 g/cm² in iron. The barometric effect on this radiation yielded an absorption mean free path of 65 ± 14 g/cm² in the atmosphere, and the zenith angle distribution was found to be that due to an absorption mean free path of 75 ± 14 g/cm². These results are shown to indicate that the radiation responsible for these large bursts consists largely of protons and of energy greater than 60 bev. (auth)

5722

INVESTIGATIONS ON LARGE COSMIC-RAY BURSTS. Edward F. Fahy. Phys. Rev. 83, 413-21(1951) July 15.

Observations on large cosmic-ray bursts have been performed at the altitude of 3500 m with a model C meter surrounded by thick lead shields. G-M counters, connected to appropriate electronic circuits, were placed over these lead shields in order to record extensive air showers simultaneously with bursts. It is found that about 2% of the 100 particle bursts and about 14% of the 1000 particle bursts under 10.7 cm Pb are produced by extensive air showers. This fraction continues to increase with increasing burst size and becomes almost 100% for bursts of more than 4000 particles. The experimental observations are consistent with the assumption that the part of the burst-producing radiation which does not consist of air showers or of μ mesons is attenuated in lead with the absorption mean free path of 346 ± 36 g/cm². The correction for the number of bursts produced by μ mesons is based on a revision of the calculations of Christy and Kusaka; the revised calculation indicates that μ mesons (spin ½) produce 68 ± 5% of the bursts in a model C meter under 10.7 cm Pb at sea level.

It is pointed out that the high energy N-component of the cosmic radiation (i.e., those particles having strong nuclear interactions with matter) can produce enough electronic radiation to account for the observed burst frequency, if $\int_0^1 z^2 p(z)dz = 0.12$, where $p(\epsilon/E)d(\epsilon/E)$ is the probability per nuclear collision that an N-ray of high energy E produces electronic radiation of energy $(\epsilon, d\epsilon)$. The neutral meson mechanism satisfies this condition, provided one assumes that practically all of the energy of a high energy N-ray is carried away by mesons when a nuclear collision in lead takes place, and that one-third of this energy goes into neutral mesons. The calculations are made on the assumption that the absorption mean free path of high energy N-rays is 124 g/cm² in air, and that the directional intensity of the primary cosmic radiation with energies greater than E bev is 0.12 $(4.5/E)^2$ sterad/cm²/sec at the top of the atmosphere. (auth)

5723

ON THE PENETRATING SHOWERS OF COSMIC RAYS. André G. Voisin. Can. J. Phys. 29, 207-16(1951) May.

Experiments have been carried out at sea level to measure penetration of particles from local showers produced in lead as a function of the angular width of the cone of shower particles. The shower particles are assumed to be mesons and are observed by counter arrangements connected in coincidence and anticoincidence. The results show that the showers containing the more penetrating particles are those of wide angular spread. The multiplicity of penetrating particles per shower is estimated to be at least 3.7, and the curve of the angular distribution shows a maximum corresponding to a shower cone of a half angle of about 15°. (auth)

5724

RELATIVE ARRIVAL TIMES OF AIR SHOWER PARTICLES. V. C. Officer. Phys. Rev. 83, 458-9(1951) July 15. (Letter to the editor)

Initial results are given on the time relationship between the arrival of air shower particles at an unshielded tray and the arrival of penetrating electrons, photons, or their products at a tray shielded by 10 cm of lead. It appears, after a correction is applied, that the soft and the penetrating components arrive within an interval of $<10^{-8}$ sec.

5725

THE PROPERTIES OF PARTICLES PRODUCING HIGH ENERGY NUCLEAR COLLISIONS IN GOLD. Melvin B. Gottlieb. Phys. Rev. 82, 349-58(1951) May 1.

A large multiplate counter-controlled cloud chamber containing 300 g/cm² of Au has been used for the study of penetrating showers at an altitude of 11,500 ft. It was found that at least 83.5% of the particles initiating these high-energy events were ionizing. The mean free path in Au for the particles producing these penetrating showers was found to be 145 ± 15 g/cm². The projected zenith angle distribution of the shower primaries could be approximately represented by $\cos^m\theta$, where m was in the range 8 to 10. The flux of particles capable of producing these high-energy showers was found to be $(1.7 \pm 1) \times 10^{-6}$/cm²/sec/steradian. This value, when compared with the flux of the primary protons at the top of the atmosphere, yielded an absorption mean free path, after application of the Gross transformation, of 77 ± 5 g/cm².

5726

NUCLEAR INTERACTIONS IN GOLD OF SECONDARY PARTICLES EMITTED IN PENETRATING SHOWERS. A. J. Hartzler. Phys. Rev. 82, 359-72(1951) May 1.

A large counter-controlled cloud chamber containing 16 Au plates totaling 308 g/cm² in thickness was operated at an altitude of 11,500 ft. Forty of the pictures of penetrating showers obtained were selected for the determination of the mean free path for nuclear collisions of ionizing secondary particles. The result was found to be 230 ± 60 g/cm², corresponding to 0.7 ± 0.2 times the cross section equal to the geometric area of the Au nucleus. The number of high-energy protons among the secondary particles used in the determination of the collision mean free path was less than 11%, and the total fraction of protons was less than 30%. The 88 ± 3% of the penetrating showers observed in the experiment showed the presence of an observable electron cascade. Evidence is given that the angular distribution of the mesons in the center-of-mass system of a nucleon-nucleon collision at energies above 1.5×10^{10} ev is not isotropic and is probably collimated in two cones of about 50° half-angle around the directions of the velocities of the nucleons in the center-of-mass system.

5727

TRANSITION EFFECTS OF STAR-PRODUCING COSMIC RADIATION IN LEAD. E. Schopper, K. H. Höcker, and G. Kuhn. Phys. Rev. 82, 444-5(1951) May 1. (Letter to the editor)

The frequency of cosmic-ray stars produced under various thickness of Pb and carbon at an altitude of 2950 m has been studied in more detail (Ann. Physik 6, 338(1949)). Photographic emulsions and special nuclear track microscopic equipment were used. A distinct maximum appears at about 1.2 cm of Pb, confirming the existence of a transition effect. A second unexplained maximum appears to start at about 15 cm of Pb.

5728

SECONDARY NUCLEONS IN LEAD. E. Schopper, K. H. Höcker, and G. Kuhn. Phys. Rev. 82, 445(1951) May 1. (Letter to the editor)

It is questioned whether the transition effect of cosmic-ray stars in Pb (Phys. Rev. 82, 444(1951)) might be due to secondary nucleons produced in the Pb. It does not seem probable that this is the case at 3000 m because at this altitude most nucleons have energy less than 10^9 ev and would produce single protons but not stars.

5729

TRANSITION EFFECT IN Pb OF THE STAR-PRODUCING RADIATION IN THE STRATOSPHERE. I. M. M. Shapiro, B. Stiller, M. Birnbaum, and F. W. O'Dell. Phys. Rev. 83, 455-6(1951) July 15. (Letter to the editor)

Ilford G-5 emulsions inserted in a narrow vertical aperture in Pb blocks were floated by means of balloons at average pressure altitudes of 1.6 and 1.0 cm Hg. A plot of the frequency of stars vs. depth in Pb shows (1) an increase in both large and small stars between "free air" and the upper surface of the Pb, (2) a drop in frequency, associated with the smaller stars, in the first cm, (3) a maximum at ≈ 27 g/cm², including stars with >6 prongs, and (4) a broader peak at ≈60 to 70 g/cm² probably representing the major contribution of locally generated secondaries.

5730

TRANSITION EFFECT IN Pb OF THE STAR-PRODUCING RADIATION IN THE STRATOSPHERE. II. Maurice M. Shapiro. Phys. Rev. 83, 456-7(1951) July 15.

A provisional interpretation is given of the results of experiments reported in the preceding abstract (NSA 5-5729). The effects of geometry and of the paths of obliquely incident protons are considered. It appears that an adequate theory of the transition effect must rely upon secondary protons and pions generated in the absorber, as well as upon neutrons.

5731

THE NUCLEAR INTERACTION LENGTH OF THE PARTICLES IN PENETRATING COSMIC-RAY SHOWERS. K. H. Barker and C. C. Butler. Proc. Phys. Soc. (London) 64A, 4-9(1951) Jan.

Observations have been made of the penetrating cosmic-ray showers at sea level. The cloud chamber was operated in a field of 7500 gauss, and the G-M counter was a 7-fold coincidence set. This was an extension of the work of Rochester and Butler (Nature 160, 855(1947); Proc. Phys. Soc. (London) 61A, 307(1948); 61B, 535(1948)) and Butler et al. (Proc. Phys. Soc. (London) 63A, 145(1950)). The data are analyzed, especially with regard to the interaction properties and the spectrum of the penetrating particles. It is concluded that the shower particles with momenta greater than 10^9ev/c must consist mainly of π mesons and protons. The number of protons is likely to be between 25 and 50% of all the shower particles. The interaction length of the shower particles with momenta greater than 10^9ev/c is found to be 18 cm lead (±20%).

5732

DECAY OF V-PARTICLES. R. Armenteros, K. H. Barker, C. C. Butler, A. Cachon, and A. H. Chapman. Nature 167, 501-3(1951) Mar. 31.

The occurrence of V tracks in the cloud chamber has again been confirmed. Probably not more than 10% of the V tracks can be explained by processes other than the spontaneous decay of new unstable particles. Momentum measurements on 54 secondary particles from neutral V decays have been made and these, together with ionization estimates, make it possible to identify with certainty both protons and mesons. Assuming that only two particles are produced by the neutral decays, two schemes are suggested to explain the photographs: $V^0 \rightarrow p^+ + \pi^-$, with the V^0 mass in the range 2000 to 2500 m_e; $V^0 \rightarrow \pi^+ + \pi^-$, with the V^0 mass about 1000 m_e. Evidence is already strong for the existence of two types of V^0 particles. Six charged decays have been observed, but no definite conclusions have been reached about the mass of the charged V particles.

5733

THE ATTENUATION OF NUCLEON CASCADES IN LEAD. W. G. V. Rosser and M. W. Swift. Phil. Mag. 42, 856-67 (1951) Aug.

The frequency variation of nuclear interactions under lead has been studied by comparing the rates of stars in Ilford G5 emulsions exposed above and below 30 cm of lead. The size frequency distribution is the same for stars in both sets of plates.

The attenuation lengths in lead are:

(305 ± 7) g/cm² for all stars,

(380 ± 65) g/cm² for penetrating showers ($n_s \geq 2$),

(405 ± 31) g/cm² for events with charged relativistic primaries,

(260 ± 34) g/cm² for events with uncharged primaries (excluding simple evaporation stars).

The ratio of the attenuation length to the interaction mean-free path for penetrating showers is (1.8 ± 0.3).

The percentage of all stars produced by charged relativistic primaries increases from (13.1 ± 0.9) % for the unshielded plates to (17.0 ± 1.0) % for the plates under lead due to the formation of stars by π mesons generated in lead. The ratio of charged to uncharged penetrating-shower primaries increases from (0.86 ± 0.21) for the air plates to (1.94 ± 0.32) for the plates exposed under 30 cm of lead. It is suggested tentatively that the increase is due to the pro-

duction of penetrating showers by fast π mesons created in the lead. (auth)

ELECTRONS

5734

ENERGY-ANGLE DISTRIBUTION OF THIN TARGET BREMSSTRAHLUNG. L. I. Schiff. Phys. Rev. 83, 252-3(1951) July 15.

The differential bremsstrahlung cross section of Bethe and Heitler is integrated over scattered electron angles to obtain an expression for the distribution in energy and angle of the radiation from fast electrons in very thin targets. Screening is taken into account through the assumption of an atomic potential $(Ze/r)\exp(-r/a)$, and the calculation is restricted to high energies and to small to moderate angles. The result is the same as that of Sommerfeld for no screening, except that the argument of the logarithm now depends on angle as well as on energy. Integration of this expression over γ-ray angle gives an analytic formula for the total intensity that is nowhere more than a few per cent higher than the Bethe-Heitler result calculated numerically on the basis of the Thomas-Fermi potential. (auth)

5735

A COMPARISON OF THEORIES OF SECONDARY EMISSION. James J. Brophy. Phys. Rev. 82, 757-8(1951) June 1. (Letter to the editor)

Wooldridge's quantum-mechanical theory of secondary emission of electrons (Phys. Rev. 56, 562(1939)) is put into a form which is more applicable to experimental results. It is noted that a remarkable similarity exists between the Wooldridge theory and the equation arrived at by the free-electron approximation of Baroody (Phys. Rev. 78, 780(1950)). Points of similarity and differences between the two are pointed out, and a graph compares both with the universal secondary efficiency curve suggested by Baroody.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

5736

A NEW METHOD OF OBSERVING COMPTON AND OTHER INCOHERENT X-RAY SCATTERING IN CRYSTALS. H. J. Grenville-Wells. Nature 168, 291(1951) Aug. 18. (Letter to the editor)

When Cu-K + white radiation impinges on a mosaic-type diamond, Laue photographs show a weak divergent-beam pattern corresponding to Cu-K wide-angle radiation. Reasons are given for concluding that this is not fluorescent radiation but must be Compton scattering, imperfection scattering (including thermal scattering), or both.

GASES

5737

Carbide and Carbon Chemicals Co., Y-12 Area

IONIZATION AND MIGRATION OF AIR AND RARE GASES. Frances Sachs. July 23, 1951. 39p. (Y-B4-20)

This bibliography contains 121 references to papers on ionization and migration of air and rare gases selected from Chemical Abstracts 1907-1949, Nuclear Science Abstracts, the AEC and Y-12 catalogs, and Wilson Cumulative Book Index, 1928-1950. A brief abstract is given for each title.

5738

CONVERGENCE OF THE CHAPMAN-ENSKOG METHOD FOR A COMPLETELY IONIZED GAS. Rolf Landshoff. Phys. Rev. 82, 442(1951) May 1. (Letter to the editor)

Calculations on the convergence of the Chapman-Enskog method (Phys. Rev. 76, 904(1949)) which may be of interest in the theory of transport phenomena in an ionized gas (Phys. Rev. 80, 230(1950)) are reported.

5739

FLOW OF GASES IN POROUS MEDIA. L. H. Wilson, W. L. Sibbitt, and M. Jakob. J. Applied Phys. 22, 1027-30 (1951) Aug.

This paper presents a brief theoretical review of the viscous and free molecular flow phenomena. The equations which describe these two types of flow are applied to flow through porous media and are combined to yield a semi-empirical equation which may be used not only for the viscous and free molecular flow, but also for the transition region between these. Experimentally determined limiting values of the ratio of molecular mean free path to pore diameter are reported. These ratios may be used to indicate the nature of flow in a porous media provided the pore size is known, or they may be used to determine pore size experimentally. (auth)

5740

CROSS SECTIONS FOR ION-ATOM COLLISIONS IN He, Ne, AND A. John A. Hornbeck and Gregory H. Wannier. Phys. Rev. 82, 458(1951) May 1. (Letter to the editor)

A method has been developed which permits accurate measurement of the drift velocity of a positive ion as it moves through a gas under the influence of a constant electric field. The results of these measurements for the ions He^+, Ne^+, and A^+ in their respective parent gases are discussed.

INSTRUMENTS

5741

Oak Ridge National Lab.

THE INDUCTION FLOWMETER FOR RADIOACTIVE LIQUIDS. W. G. James. June 25, 1951. 59p. (ORNL-1013)

A brief discussion of the theory of the induction flowmeter is presented, and the considerations necessary in the design of a-c induction flowmeters for radioactive liquids having low flow rates are discussed in detail. It might be concluded that, for the range of 0 to 50 ml/min, the a-c induction flowmeter is quite practical, provided the liquid conductivity is at least as great as that of tap water. For such liquids, one can expect a linearity of ± 0.25 ml/min and a stability of ± 0.5 ml/min if a well-regulated power supply is provided. Less conducting liquids could be handled by designing more specifically for this application, but it is questionable that the linearity and stability could be appreciably improved. Other authors have reported that higher flow rates can be handled, and probably with greater ease. The upper limit of practicality has not been reported, but it is undoubtedly several orders of magnitude greater than 50 ml/min. (auth)

5742

National Research Council of Canada

BETA-RAY THICKNESS GAUGES (Divisional Report No. PR-90). W. R. Dixon. Mar. 1951. 15p. (NRC-2358)

Basic information relevant to the design and operation of β-ray thickness gauges is given. Sensitivity, linearity, accuracy, and the effect of statistical fluctuations are considered. Some suitable β sources are tabulated. A laboratory model of a β-ray thickness gauge has been constructed, and the geometry of the head, the electronic circuit, and a photograph of an interior view of the instrument are shown. Absorption curves are included for a RaDEF (Pb^{210}, Bi^{210}, and Po^{210}) and a P^{32} source and for different sizes of the apertures.

5743

Argonne National Lab.

CONCENTRATION MEASUREMENTS OF FREON BY AN IONIZATION METHOD; PROGRESS REPORT, p.169-76 of DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; QUARTERLY REPORT, AUGUST, SEPTEMBER,

OCTOBER, 1950. H. A. Schultz, R. E. Rowland, and L. D. Marinelli. [nd] 8p. (ANL-4531(p.169-76))

The direct measurement of the diffusion of gaseous contaminants in air requires the use of an appropriate tracer. Freon 12 (dichlorodifluoromethane) is well suited for this purpose. However, instruments for detecting its presence have not yet been refined to the point that they can be used for reproducible measurements of concentrations in the "trace" range of a few parts per million or less. The development of a field ionization-type detector suitable for this purpose is discussed, and improvements to be made on the instrument are outlined.

5744

RCA Labs. Div., Radio Corp. of America

ELECTRONIC DEVICES FOR NUCLEAR PHYSICS; QUARTERLY REPORT; APRIL 1951–JULY 1951. G. A. Morton, Director. Aug. 13, 1951. 24p. (NP-3314)

Design modifications in a large-cathode photomultiplier tube designated as H-5037 and in a high-gain, high-current photomultiplier, both suitable for use in γ-ray spectroscopy, are described briefly and sketched. Various pulsed light sources capable of producing artificial scintillations of constant luminosity are illustrated, and development of a quantizing tube with both magnetic and electrostatic focusing is mentioned. 12 figures.

5745

Brookhaven National Lab.

USE OF KILOCURIE RADIATION SOURCES. Bernard Manowitz. July 10, 1951. 7p. (AECU-1597)

Studies are now being made on possible applications of radioactive waste materials from reactors to determine whether their processing is justified. Brookhaven is producing 1000- to 2000-curie sources to simulate radiations from these wastes. The sources are Co^{60} and Ta^{182}. They will be used in research and will be made available to industry for testing.

5746

Office of Basic Instrumentation, NBS.

REPORT OF THE OFFICE OF BASIC INSTRUMENTATION; NATIONAL BUREAU OF STANDARDS; FOR THE QUARTER ENDING SEPTEMBER 30, 1950. W. A. Wildhack. [nd] 12p. (NP-3136)

Brief statements are given of objective, background, and status of development of a spring transducer, pneumatic gas analyzer, nuclear-resonance magnetic-field meter, phase-contrast optical microscope, mutual inductance transducer, accelerometers, strain gages, absolute measurement of vibration amplitudes, electron interferometer, pulsed photomultiplier particle detector, and mass spectrometer. No scientific data are included.

5747

Department of Mines and Technical Surveys (Canada)

A DEKATRON SCALE OF 400. (Topical Report TR-89/51); by J. C. Baker and G. G. Eichholz. Aug. 22, 1951. 7p. (NP-3320)

A scale of 400 suitable for situations requiring only low counting rates but long life and little maintenance, such as continuous assay of mill tailings, is described. The circuit includes two Dekatrons (self-contained cold-cathode scaling tubes) preceded by two Higinbotham scaling stages to give a maximum counting rate of 2400 counts/sec. 2 figures.

5748

National Standards Lab. (Australia)

A GENERAL PURPOSE PHOTOELECTRIC TRICOLORIMETER; by H. F. Pollard. Nov. 1950. 19p. (PA-10)

The theory and optical data used in design of a photoelectric tricolorimeter are summarized, computation of the chromaticity coordinates of a given color is outlined, and the instrument is described and illustrated. 4 figures.

5749

PRESSURE DEPENDENCE OF SENSITIVITY OF PHOTOELECTRON COUNTERS. Ryumyo Ito. J. Phys. Soc. Japan 6, 188-91(1951) May-June.

A windowless photoelectron counter (G-M type) was used for the detection of extreme ultraviolet light and to show experimentally the pressure dependence of the sensitivity of a hydrogen-filled counter. Results show that pressure is directly proportional to the counter voltage and inversely proportional to the counting rate. Theoretical interpretation of the results are discussed.

5750

DETERMINATION OF ISOTOPE RATIOS, e.g., IN TRACER WORK, BY AN INFRARED ABSORPTION METHOD. J. M. W. Milatz, J. C. Kluyver, and J. Hardebol. J. Chem. Phys. 19, 887-8(1951) July.

In a gas analyzer of the positive filtering type for the determination of isotope ratios by an infrared absorption method, infrared radiation is interrupted 50 times per second before being sent through the absorption cell and then to a detector sensitive only at 50 cycles. The instrument is calibrated with the absorption cell void of the isotope being studied while the detector cell is filled with gas containing that particular isotope. With the absorption cell then filled with a gas containing the isotope the radiation reaching the detector will be decreased, showing a corresponding decrease in the galvanometer reading. The change in reading is a measure of the concentration.

5751

A WAY OF IMPROVING ION SOURCES. Otto Reifenschweiler. Z. Naturforsch. 6a, 331-2(1951) June. (Note; in German)

Ion yields of sources involving a gaseous-discharge tube, from which ions pass through a "canal" into an evacuated container, can be increased by subdividing the conductor forming the canal into 3 pieces of appropriate shape, charged to appropriate potentials; the electric-optical properties of the system are thereby improved.

5752

OPTICAL FOCUSING OF NEUTRAL ATOM BEAMS. H. Friedburg and W. Paul. Naturwissenschaften 38, 159-60 (1951) Apr.

It is shown that a magnetic field $H_x = D(X^2 - Y^2)/2c$, $H_y = -Dxy/c$, $H_z = 0$ (D is a coefficient), acts as a converging lens on a beam of neutral atoms having a negative magnetic quantum number and moving with a velocity v_z. The chromatic aberration, caused by the presence of atoms of different v_z in a beam, can be eliminated by observing in a pulsing, instead of a continuously changing, magnetic field. This theory was confirmed experimentally by means of a K-atom beam passing through a field within a hexagon with sides 1 mm long; the hexagon was formed by crossing six 18-cm-long wires that carried an a-c of 430 amp maximal intensity.

5753

ON THE TEMPERATURE EFFECTS OF SPURIOUS COUNTS IN GEIGER-MUELLER COUNTERS. Motoharu Kimura. J. Phys. Soc. Japan 6, 141-8(1951) May-June.

The temperature effect on the rate of spurious discharges in G-M counters (hard glass sealed-off type with outgassed cathode of 2 cm $\phi \times$ 5 cm) was observed when they were heated and cooled at constant rates. On heating, the rate of natural counts increased in various manners which depended on the filling gases and on the cathode material, and decreased rapidly on cooling without exception. It was verified that these discharges were due to the so-called "Spontanentladung" of Trost, and the occurrence of the double or triple discharges (Nachentladung) was very small. The plateau curves were taken with gamma ray

source and also without any source before and after each experiment. No marked changes were found in them, though those with natural counts became generally better after being cooled. The plateau lengths were generally between 100 to 500 v, with the slopes of 0.6 to 10%/100 v. The counts decreased exponentially with the square root of time when the counter was kept at constant temperature near 100°C after raised to that point. Tentative explanation can be made along the lines of so-called Malter effect of the thin oxide film of the cathode, but the effect of adsorption and evaporation of the quenching gas molecules and also the negative ions at the cathode surfaces cannot be neglected. (auth)

5754

IMPROVED COUNTING RATE METER FOR X-RAY MEASUREMENT. Gunji Shinoda and Teruichi Tomura. J. Phys. Soc. Japan 6, 148-52(1951) May-June.

A new type instrument for measurement of x-ray intensity with a G-M counter is described. The advantages of this counting rate meter are as follows: (1) statistical fractional standard deviations are constant throughout whole range of $1:10^4$, (2) probable errors are also made constant by means of logarithmic scale, (3) the time required for reading is shorter in higher counting rate, and (4) therefore it is beneficial to measure the counting rate from natural counting to saturate counting with probable error less than 3%, using an 0.8% accuracy meter and with only one scale. (auth)

5755

THE TIME DEPENDENCE OF THE SENSITIVITY OF PHOTOMULTIPLIER TUBES. M. Hillert. J. Applied Phys. 2, 164-7(1951) June.

A study has been made of the regular changes in sensitivity occurring in photomultiplier tubes under typical operating conditions. The particular phenomenon which takes place in the first minutes after a sudden alteration has been made in the illumination, was investigated in detail. An expression is given, capable of describing this change in the case of a sudden increase in the illumination to which the tube is submitted. Certain experimental results indicate that the dynodes are responsible for this effect. Finally, an electrical model of the behavior of the dynodes is outlined, which functions according to the expression found for the time dependence of the sensitivity. (auth)

5756

NUCLEAR SCINTILLATION COUNTERS. J. B. Birks. J. Brit. Inst. Engrs. 11, 209-20(1951) June.

The various physical processes affecting the design of the nuclear scintillation counter are discussed, with particular reference to the most suitable phosphors and photomultipliers. The advantages of the instrument over the conventional gas ionization counter are considered and illustrated by reference to typical experimental applications in nuclear physics.

5757

SHIELDED MILLING MACHINE FOR CYCLOTRON TARGETS. M. Stanley Livingston. Rev. Sci. Instruments 22, 428-9(1951) June. (Laboratory and shop notes)

A Pb-shielded machine has been built for milling off the active layer of cyclotron targets. Targets are inserted in a vise with long-handled tongs and clamped in place with face parallel to the plane of a steel fly-cutter. One feed screw is adjusted to give the desired depth of cut, and the operator cranks another feed screw to move the target across the cutter. In operation a 50-mc target has been inserted, shaved, and removed with a total exposure to the operator of 5 mrep, as observed on a pocket dosimeter.

5758

A SENSITIVE METHOD OF RECORDING NUCLEAR INDUCTION SIGNALS. I. M. Ross and F. B. Johnson. Nature 167, 286-7(1951) Feb. 17. (Letter to the editor)

Use of photographic means to improve the presentation of a signal/noise ratio obtained by oscillograph is made. In order to discriminate also against correlated noise, that is, noise related to or having its origin in the field modulation, the camera film is stepped forward by a few millimeters after each exposure, while simultaneously the magnetic field intensity is stepped up or down by a suitable increment. The signal then appears as a sloping trace on the pattern formed by the successive exposures. Each line may represent several hundred forward sweeps of the modulation, the back sweep in each case being blanked out. Portions of the spectrum recorded in this way on a spectrometer working at a fixed frequency of 1 Mc/sec are depicted. Cu^{63}, Cu^{65}, Br^{79}, and Br^{81} signals are distinguishable from the correlated noise in each case.

5759

THE USE OF GATED-BEAM TUBES IN COINCIDENCE CIRCUITS. B. Smaller and E. Avery. Rev. Sci. Instruments 22, 341(1951) May. (Laboratory and shop notes)

A coincidence circuit is described for use with scintillation counters. This circuit uses the conventional one-shot multivibrator, or univibrator "Electronics, Experimental Techniques," (W. C. Elmore, McGraw-Hill Book Company, Inc., New York, 1949, 91p.), as a pulse shaper with the innovation of using the newly designed gated-beam tube as a coincidence mixer. Resolving times as low as 2×10^{-8} sec have been achieved.

5760

ON THE MOTION OF PARTICLES WITH MAGNETIC MOMENTS IN AN EXPONENTIAL MAGNETIC FIELD. Ya. M. Fogel. Zhur. Ekspti'. i Teoret. Fiz. 21, 38-41(1951) Jan. (In Russian)

A theoretical study is made of the motion of molecules with magnetic moments under the action of both an exponential magnetic field and the field of gravity. It is found that a separation of the molecular beam according to masses will occur; however, the intensity of the separated beams will be very small, so that the finding of the focal line would require highly sensitive detectors. (auth)

5761

OBSERVATION OF NUCLEAR MAGNETIC RESONANCE WITHOUT CONTINUOUS SWEEP. Georges-Jean Béné, Pierre-Maurice Denis, and Richard-Charles Extermann. Compt. rend. 231, 1294(1950) Dec. 6. (In French)

The necessity for sweeping either the uniform magnetic field H_0 or the high-frequency oscillating field H_ω in order to distinguish the transmitted and received signals may be avoided by varying H_0 from slightly below to slightly above the resonance value H^*, defined by the relation $\omega = \gamma H^*$, where ω is the pulsation of H_ω and γ is the gyromagnetic ratio. An oscillogram illustrating the separation by this method of the nuclear induction signal in a 0.1N $NiSO_4$ solution is shown.

5762

AUXILIARY EQUIPMENT TO BE USED WITH A BETA-RAY SPECTROMETER FOR THE STUDY OF RADIOACTIVE GASES. Michel Ter-Pogossian, Fred T. Porter, and C. Sharp Cook. Rev. Sci. Instruments 22, 389-92(1951) June.

A system is described whereby a gas may be circulated continuously between the cyclotron and the 14-cm radius of curvature magnetic spectrometer. This apparatus does

not modify the spectrometer itself but considerably increases its usefulness. Detailed descriptions are given of the chamber which is attached to the cyclotron for bombardment and of both beta- and gamma-ray source holders in addition to an over-all picture of the entire system. (auth)

ISOTOPES

5763

California Univ.

ISOTOPES OF NEPTUNIUM AND PLUTONIUM. (dissertation) Donald Alfred Orth. Dec. 1950. Decl. Sept. 11, 1951. 43p. (AECD-3231; UCRL-1059)

U targets were bombarded with He ions and deuterons. Rapid chemical procedures were developed for separation of the resulting Np and Pu fractions. Pu^{234} from the $U^{233}(\alpha,3n)Pu^{234}$ and $U^{235}(\alpha,5n)Pu^{234}$ reactions was found to decay by 6.19 ± 0.01-Mev α emission and electron capture with a branching ratio of ~25 EC/α, and a 9.0 ± 0.5-hr Pu^{232} from the $U^{235}(\alpha,7n)$ reaction has a 36 ± 2-min half life. Energies of the α peaks in the series initiated by Pu^{232} disintegration are Pu^{232}, 6.58 Mev; U^{228}, 6.67 ± 0.02 Mev; Th^{224}, 7.13 ± 0.02 Mev; Ra^{220}, 7.43 ± 0.03 Mev; Em^{216}, 8.01 ± 0.03 Mev. A limit of <60 was placed on the EC/α branching ratio for Pu^{232}. Pu^{235} from $U^{233}(\alpha,2n)Pu^{235}$ has a half life of 26 ± 2 min. The radiations appear to be primarily L x rays, with a small amount of harder radiation. The estimated partial α half life of Pu^{235} is long, and the α energy is expected to lie between Pu^{234} and Pu^{236}. The isotopes Np^{234} and Np^{236} were produced by deuteron bombardments on U^{235} (99.94%) by the (d,3n) and (d,n) reactions, respectively. In the decay of Np^{234}, α particles of 0.80, 0.18, 0.44, and 1.42 Mev are indicated; conversion-electron groups of 0.3 and 0.7 Mev are well-defined; and the amount of L-electron capture is apparently of the same order of magnitude as K capture. A decay scheme is proposed for 22-hr Np^{236} which gives a ratio of total EC/β of 2 and L/K capture ratio of 2. An activity of half life 60 ± 2 min was tentatively assigned to Np^{241} from the reaction $U^{238}(\alpha,p)Np^{241}$.

5764

Los Alamos Scientific Lab. and New Mexico Univ.

SOME NEW ISOTOPES OF ANTIMONY AND TIN; by John W. Barnes and Arthur J. Freedman. [nd] Decl. Sept. 10, 1951. 4p. (AECD-3232; LADC-1033)

A 1.5-hr Sn activity has been identified as Sn^{127}, the parent of known 93-hr Sb^{127}. Sb milked from fission product Sn was shown to be Sb^{127} by its decay and absorption curves and by the half life of its daughter, 9.3-hr Te^{127}. A 9-hr Sb activity as been assigned to Sb^{126}, while its parent Sn^{126} has a 50-min half life. The 9-hr Sb^{126} shows at least one β ray of energy 7 Mev and two γ rays of energies 0.90 ± 0.05 and ~0.4 Mev. A 10-min activity also appears in the decay of Sb grown from fission product Sn. The half life of the Sn parent of this activity is estimated at <1 hr. A period of ~30 days occurs in the decay of fission product Sb. The fission yield of this activity relative to 93-hr Sb^{127} is higher for 14-Mev fission than for thermal fission, and hence, this activity probably belongs to a mass chain lower than 127.

5765

Radiation Lab., Univ. of Calif.

COUNTING EFFICIENCY OF BISMUTH 205 AND BRANCHING RATIO OF POLONIUM 205. Kenneth L. Hall. Aug. 29, 1951. 22p. (UCRL-1460)

The counting efficiency of Bi^{205} has been determined by relating its electron capture activity to the α-counting rate of its At^{209} parent. This datum was used to determine the branching ratio of Po^{205} corresponding to a partial α half life of 0.23 ± 0.05 yr. The α-particle energy is 5.21 ± 0.10 Mev. Using the Gamow formula, values of the α half life have been calculated for various values of the nuclear radius and α energy and are plotted. The α half life of Po^{205} is discussed in terms of a hindered decay or a deviation from the normal nuclear radius.

5766

Ames Lab.

THE BETA-SPECTRA OF P^{32} AND P^{33}. Erling N. Jensen, R. T. Nichols, J. Clement, and A. Pohm. Aug. 13, 1951. 34p. (ISC-157)

The β spectrum of P^{32} has been examined with a thin-lens spectrometer. The maximum energy of the 14.3-day β activity, as determined from several Kurie plots, was found to be 1.704 ± 0.008 Mev. The Kurie plots gave excellent straight lines from the maximum β energy to about 0.26 Mev. In P samples prepared from neutron irradiated S an additional β activity was observed having a maximum energy of 0.26 ± 0.02 Mev and a half life of 24.8 ± 0.5 days. This low-energy β group was also observed in P samples prepared from S and LiCl irradiated with x rays having a maximum energy of 68 Mev. The low-energy β group was not observed in P samples prepared from S irradiated with deuterons or P irradiated with neutrons. The low-energy β group is ascribed to P^{33}. (auth)

5767

Los Alamos Scientific Lab.

GENETIC RELATIONSHIPS AND FISSION YIELDS OF MEMBERS OF THE MASS-115 DECAY CHAIN. Arthur C. Wahl and Norman A. Bonner. [nd] Decl. Sept. 6, 1951. 25p. (AECD-3230; LADC-979)

The genetic relationships of the Cd isomers with other members of the Ag^{115} (21 min)–Cd^{115} (53-hr and 43-day)–In^{115} (4.5-hr) decay chain have been investigated. The fission yields of several chain members have been measured for both thermal-neutron-induced and 14-Mev-neutron-induced U^{235} fission. The 21-min Ag^{115} was found to decay to both Cd^{115} isomers, 9% going to the 43-day state and 91% to the 53-hr state. Neither of the Cd isomers decays to the other. The 53-hr Cd isomer decays to the 4.5-hr In^{115}, but the 43-day isomer does not. The U^{235} thermal-neutron-fission yields of the 21-min Ag, 53-hr Cd, and 43-day Cd were determined to be 0.0078, 0.0098, and 0.00071%, respectively. All of the 43-day Cd isomer formed in fission grows from the 21-min Ag, but 28% of the 53-hr isomer is formed by some other path. The fission yield of each of the Cd isomers increases a hundredfold when the energy of the neutrons is increased to 14 Mev.

5768

ISOTOPIC COMPOSITION OF ARGON IN A NATURAL GAS. G. Boato, G. Careri, and G. Nencini. Ann. geofis. (Rome) 4, 111-12(1951) Jan. (Letter to the editor; in Italian)

In samples of natural gas from boron-containing steam jets (soffioni) in Larderello, Italy, the ratio A^{40}/A^{36} was 1.230 to 1.315 times as high as in air.

ISOTOPES SEPARATION

5769

GASEOUS DIFFUSION AS A RANDOM PROCESS. W. H. Furry and P. H. Pitkanen. J. Chem. Phys. 19, 729-38 (1951) June.

It has long been known that the problem of random flights of a single molecule provides in principle a method for calculating the diffusion coefficient D_{12} for the case in which the concentration of the diffusing component is small. This method has been, in effect, an elementary and rather crude one, because correlations of speed and direction were not taken into account and, accordingly, the rather ambiguous concept of mean free path had to be given an arbitrary definition. In this paper these difficulties are overcome and an accurate treatment is given of gaseous

diffusion based on the random-flight method. The determination of the diffusion coefficient is made to depend on the solution of an integral equation; the unknown function of this equation can be interpreted as the unambiguously defined effective mean free path, for diffusion, of molecules of given speed. The resulting value of D_{12} is the same as is obtained from the standard Enskog-Chapman treatment based on Boltzmann's equation. (auth)

5770

THE EXCHANGE OF WATER BETWEEN HYDRATED CATIONS AND SOLVENT. John P. Hunt and Henry Taube. J. Chem. Phys. 19, 602-9(1951) May.

The rate of exchange of water between the hydrated forms of Al^{+3}, Cr^{+3}, Fe^{+3}, Ga^{+3}, and Th^{+4} and the solvent water has been measured in solutions of varying acidity. With the exception of chromic ion, and of ferric ion at low acidity, the exchange is complete in ~3 min at 25°C. For chromic ion, the half time for exchange is independent of acidity over a wide range and is ~40 hr at 1M salt concentration. The coordination number of chromic ion for water over the entire acidity range is 6.0. The initial hold-back of oxygen by ferric ion at low acid concentration is slight and is attributed to the presence of polynuclear hydrolyzed species. For all the cations, the distribution of oxygen isotopes in the final solution is noticeably different from random, the cations showing a greater affinity for H_2O^{18} over H_2O^{16}. The rates of exchange are correlated with the electronic structure, which influences the energy required to form the transition state. (auth)

5771

THE SEPARATION TUBE. IX. PREPARATION OF PURE HEAVY NITROGEN N^{15}. Klaus Clusius. Helv. Chim. Acta 33, 2134-52(1950) Dec. 1. (In German)

Practically all N^{15} in ordinary nitrogen is combined into $N^{15}N^{14}$ molecules, and, owing to their unreadiness to dissociate according to the equation $2N^{15}N^{14} \rightleftarrows N_2^{15} + N_2^{14}$, a separation of nitrogen in a thermodiffusion tube yields $N^{15}N^{14}$, not N_2^{15}. However, by introducing an appropriate catalyst (e.g., a metal of the Fe group) or by using electric-spark discharges, the dissociation can be furthered. The spark method was adopted in the construction of an apparatus of only 3.8-m height, consisting of many thermodiffusion separation units interconnected by means of convection tubes. A special device for holding the heating wire in the axis of the separation tube and preventing its oscillations permitted the use of a-c current for heating. The enrichment obtained was 99.8% N^{15}. A theoretical examination showed that the concentration gradient in a temperature field, as existing in a thermodiffusion tube, differs considerably in two-component and three-component systems (in the present case the system was N_2^{15}-$N^{15}N^{14}$-N_2^{14}). The experiments described afforded a validity test for a statistical explanation of thermodiffusion by the maximum-entropy law (Schaefer, Angew. Chem. 58, 83(1947)); the facts did not confirm this explanation.

MASS SPECTROGRAPHY

5772

N^{15} TRACER REACTIONS. II. SPECTROSCOPIC MICRODETERMINATION OF N^{15}. Michael Hoch and Hermann-Rolf Weisser. Helv. Chim. Acta 33, 2128-34(1950) Dec. 1. (In German)

The defect of mass spectrometry is the difficulty of distinguishing between molecules of very close weights; e.g., in the analysis of a N_2^{14}-N_2^{15} mixture the results are distorted by the frequent presence of $C^{12}O^{16}$ and $N^{14}O^{16}$. The method described uses photometry of ultraviolet band spectra obtained in electrodeless capillary glow-discharge tubes. Determinations of the N^{15}/N^{14} ratios in quantities of N_2 as low as 50 μg can be made with a possible error of ±2% in the darkening measurements; the above-mentioned impurities do not interfere. In Part I of the present work (Clusius and Hoch, Helv. Chim. Acta 33, 2122(1950)) a report is given of an application of the new method to a tracer study of the mechanism of the disintegration of phenylhydrazine in distillation.

MATHEMATICS

5773

Los Alamos Scientific Lab.

ASSOCIATED CONVEX BODIES. Preston C. Hammer. [nd] 11p. (AECU-1588)

Some of the author's results for 2-dimensional convex bodies are extended to n-dimensional convex bodies. This work deals with affine invariants and makes possible a decomposition of convex bodies, in n-dimensional Euclidean space, into certain classes. For every convex body C not symmetric with respect to a point it is shown that there exists a subbody which may be termed irreducible and which may in a sense be considered the "center" of C.

5774

APPROXIMATE EIGENSOLUTIONS OF $(d^2\phi/dx^2) + [a + b(e^{-x}/x)]\phi = 0$. Lamek Hulthén and K. V. Laurikainen. Rays. Modern Phys. 23, 1-9(1951) Jan.

While studying photodisintegration of the deuteron and capture of neutrons by protons (Phys. Rev. 76, 1163-5; 79 166-7 and 909-10(1950)), the authors found it necessary to extend previous calculations (Arkiv Mat. Astron. Fysik 23A, No. 5, 1-12(1942)) on approximate solutions of $(d^2\phi/dx^2) + [a + b(e^{-x}/x)]\phi = 0$. Results are tabulated.

5775

ENERGY LEVEL PERTURBATION OF A PARTICLE IN A SPHEROIDAL POTENTIAL WELL. S. Gallone and C. Salvetti. Phys. Rev. 82, 551(1951) May 15. (Letter to the editor)

Brief mathematical treatment is given to the motion of a nucleon in a spheroidal well of type $R(\mu) = R_0[1 + \sum_{i=2}^{\infty} \alpha_i P_i(\mu)]$ where μ = direction cosine of the nucleon position vector and R_0 = the renormalized radius of the core. The formulas derived, together with the expression of the surface and electrostatic deformation energy, may be used for a variational calculation of the contribution of the P_4 deformation to the total energy shift.

MEASURING INSTRUMENTS AND TECHNIQUES

5776

Institute for Nuclear Studies, Univ. of Chicago

ON THE POSITIVE PARTICLES APPEARING NEAR BETA-RAY EMITTERS; PART II, SECT. 10, p.56-84 of RESEARCH PROGRAM WITH THE CHICAGO CYCLOTRON; PROGRESS REPORT; AUGUST 1, 1949, TO AUGUST 1, 1950. Gerhart Groetzinger, Fred L. Ribe, and David Kahn. [nd] 29p. (NP-3182(p.56-84))

Experiments performed with a cloud-chamber to investigate the existence of the positive tracks near β-ray emitters are reported. It was found that, depending upon the source arrangement and the type of investigation of cloud-chamber photographs, a considerable fraction of observed "positive" tracks may be due to electrons which reenter or appear to reenter the source. With stereoscopic analysis and an appropriate source arrangement the fraction of spurious positive tracks may be reduced to a few per cent. With these precautions, a ratio of positive particles to electrons of 3×10^{-4} was found for P^{32}. This ratio is increased by covering the source with carbon or lead. An investigation of multiple scattering in the gas of the chamber shows a higher multiple scattering of the positive particles than that of the electrons of the same momentum. The observed

dependence of the scattering on the momentum is consistent with that of singly charged particles of mass 2. While previous attempts to detect these particles with β-ray spectrometers failed, an arrangement using a 180° spectrograph of 4-cm path length and electron-sensitive nuclear emulsions gave a yield of 8×10^{-4} positive particles per electron at $H\rho$ = 1600 gauss-cm. (see also Phys. Rev. 80, 108(1950) Oct. 1) (auth)

5777

New York Univ.

FLUORESCENCE OF ORGANIC SOLUTIONS; PART I, p.6-49 of FLUORESCENCE AND CONDUCTIVITY PHENOMENA; PROGRESS REPORT NO. 4 COVERING PERIOD JANUARY 1, 1950; TO JANUARY 31, 1951. Hartmut Kallmann. May 1951. 43p. (NP-3171(p.6-49))

The fluorescence of organic solutions under high-energy γ excitation was investigated. The "practical" values of light efficiency (in a reflecting, porcelain beaker) were measured with a 1P28 photomultiplier, and results are tabulated. The best solvents are phenylcyclohexane and diphenyl oxide (phenyl ether). Other very good solvents are xylene, toluene, benzene, p-dioxane, phenetole, p-cymene, cumene, and tetrohydronaphthalene. The best solutes are anthranilic acid, diphenylhexatriene, alpha-naphthylamine, phenyl alpha-naphthylamine, and terphenyl. The true relative physical light efficiencies (in a nonreflecting, blackened beaker) were measured by means of two photomultipliers of different spectral sensitivities. Three curves of meter readings vs. concentration show very close agreement with the theory that variation of light emission with concentration can be described by three constants, one essentially describing the energy transfer from the solvent to the solute, another describing the internal quenching of the energy within the solute molecule, and a third describing the interaction between the solute molecules themselves (self-quenching). Results of tests on solutions containing methyl-p-amino benzoate and diphenylhexatriene in varying concentrations suggest that the self-quenching effect means not so much a quenching of the excitation energy but more a quenching of the ability to emit light. The light output under α bombardment was found to be much less than that for the same amount of absorbed energy from γ excitation. An intensity decay under continuous α irradiation was observed. Brief sections are devoted to quenching by additional impurities and to visible observation of fluorescence.

5778

New York Univ.

TIME CONSTANT AND AMPLITUDE MEASUREMENTS OF SCINTILLATION PULSES; PART II, p.50-66 of FLUORESCENCE AND CONDUCTIVITY PHENOMENA; PROGRESS REPORT NO. 4 COVERING PERIOD JANUARY 1, 1950, TO JANUARY 31, 1951. Hartmut Kallmann. May 1951. 17p. (NP-3171(p.50-66))

A circuit is described by which the time constant of a decaying scintillation pulse can be determined from measurements of the relative pulse heights when the input circuit time constant is varied. Relative peak heights and time constants of various single crystals, powders, and solutions subjected to γ and to α irradiation have been determined over a time-constant range of 3×10^{-9} to 10^{-6} sec. A consideration of the pulse heights induced by γ radiation reveals that stilbene is the best crystal; stilbene pulse heights even exceed anthracene by about 25 to 30%. The theory of the method of time-constant measurements is outlined, and time constants are calculated from the voltage ratio of neighboring resistors. These figures indicate that it is impossible to describe the light flash by one single exponential function, but in many cases the long-time component cannot be very strong. Calculations indicate that anthracene when excited by γ rays has a short time constant of 1.4×10^{-8} sec and a longer time constant of 6.8×10^{-8} sec. The amplitude in the longer case is about 4% of that in the shorter.

5779

Vanderbilt Univ.

THE SCINTILLATION SPECTROMETER AS A MEANS OF MEASURING CONVERSION COEFFICIENTS. (thesis) Thomas B. Cook, Jr. July 20, 1951. 72p. (AECU-1598)

A comparison method has been devised for the determination of conversion coefficients by the use of a scintillation spectrometer. This method gives greater accuracy than any now used for measurements of this type on transitions not accompanied by β spectra. A scintillation spectrometer has been assembled and used to measure the internal-conversion coefficient of the 105-min, 0.39-Mev isomeric transition in In^{113}, an electric furnace for growing anthracene crystals has been constructed, and a procedure has been developed for producing good crystals. A value of 0.55 ± 0.04 for the conversion coefficient of the 105-min isomeric transition of In^{113} was obtained by comparison of the data on Sn^{113} with that on Au^{198} and the use of 0.031 as the K-conversion coefficient for the 0.411-Mev transition of Hg^{198}.

5780

Brookhaven National Lab.

SCINTILLATION NEUTRON DETECTOR. (abstract) William Bernstein and A. W. Schardt. [nd] 1p. (AECU-1600)

The report is reproduced here in its entirety.

Lithium iodide crystals have been grown with up to 0.5% by weight of TlI as activator. The activated melt forms an opaque, brown, polycrystalline mass if cooled rapidly. Single crystals ½ in. in diameter and ¾ in. high have been grown with parts which are clear and white. Excess thallium was found at the crystal boundaries. The crystals were tested with thermal neutrons from a spectrometer. All activated crystals gave pulses well above noise whereas no scintillations were detected from unactivated crystals. A single line with a full width at half maximum of 25% was obtained with under-activated crystals. The pulse height corresponded to that produced by 50- to 100-kev gamma rays on Harshaw NaI-Tl. Crystals grown with an excess of activator showed one line equivalent to 100 to 170 kev on NaI-Tl. A continuous distribution of pulses was found above the line with a cutoff at 450 kev NaI-Tl equivalent. One crystal shows a second peak near the upper cutoff which is about 15% wide. All pulses are stopped by interposing cadmium between the crystal and neutron source.

5781

Brookhaven National Lab.

A CRYSTAL SPECTROMETER FOR NEUTRONS. (abstract) L. B. Borst and V. L. Sailor. [nd] 1p. (AECU-1603)

The report is reproduced here in its entirety.

A crystal spectrometer of the type described by Zinn (Phys. Rev. 71, 752 (1947)) has been constructed for use with the Brookhaven reactor. A beryllium crystal has been found to be exceptionally good as a neutron monochromator giving unusually strong Bragg reflections while having a double-crystal rocking curve of only 5′ width. (Two excellent single crystals of beryllium were generously furnished by Prof. A. R. Kaufmann of the Division of Industrial Cooperation at M.I.T.) The high intensity permits the use of planes of high Miller indices, which greatly enhances the resolution of the instrument. For example the $(12\bar{3}0)$ set of planes have a grating space of only 0.747 A, which gives a first-order reflection for 1-ev neutrons at an angle of 11°. Using this set of planes, preliminary

cross-section curves have been obtained for In, Ir, Rh, and Au in the range from 1 to 10 ev. With a collimated beam of 10′ divergence the resolution is high enough to permit the observation of the natural widths of most resonances lying below 2.5 ev. At present more careful data are being taken on several resonances to obtain accurate values of the resonance integrals.

5782

Brookhaven National Lab.

A NEW FILM PACKET FOR RADIATION DOSIMETRY. William C. Herman. [nd] 6p. (AECU-1601)

A film packet for personnel monitoring contains du Pont type 508 x-ray film as the sensitive component and Defender Adlux as the insensitive film. The sensitive film can be read down to about 15 mr. The ranges of the two films overlap in the vicinity of 5 r. The useful dosage range of the Adlux film extends to about 750 r. Processing of all films used is done by the time and temperature method in du Pont concentrated liquid x-ray developer. No further description of the packet is given.

5783

Oak Ridge National Lab.

GAMMA-RAY CONTAMINATION IN THE THERMAL NEUTRON EXPOSURE FACILITY OF THE OAK RIDGE REACTOR. Edgar B. Darden, Jr., C. W. Sheppard, and L. C. Emerson. Sept. 6, 1951. 37p. (ORNL-1003)

A small ion chamber of the Sievert condenser type constructed of Be and teflon has been developed for measurement of the intensity of γ radiation in the presence of a neutron flux. The chamber is charged and exposed, and the amount of discharge then read on an ordinary Victoreen r meter. The presence of the chamber does not depress the neutron flux nor are appreciable amounts of capture γ rays generated by it. With the aid of this instrument a study was made of the nature of the γ radiation present in the exposure facility located in the thermal column of the Oak Ridge reactor. It was found that the air dose received in the graphite treatment box amounted to as much as 11 r/min, depending on the position of the measuring instrument, and that this intensity was roughly proportional to the neutron flux at that point. The radiation shows maximum penetration in Pb corresponding to an energy of 2½ to 5 Mev. It appears to be originating from a source or sources immediately adjacent to the exposure region, probably from a contaminant of high-capture cross section present in the Bi walls of the facility.

5784

Carbide and Carbon Chemicals Co., Y-12 Area

NEUTRON DETECTORS. Frances Sachs. July 12, 1951. 36p. (Y-B4-18)

This bibliography contains 128 titles listed under the following headings: radiation detection—general, fission detectors, neutron-capture detectors, photographic detectors, recoil proton detectors, scintillation detectors, boron-coated thermopiles, velocity selectors, and miscellaneous neutron detectors. A brief abstract is given for each title.

5785

Los Alamos Scientific Lab. and New Mexico Univ.

INVESTIGATION OF LOW-LEVEL COUNTING TECHNIQUES; I. PULSE-HEIGHT DISCRIMINATION METHODS; Arthur J. Freedman and Ernest C. Anderson. [nd] 20p. (AECU-1609; LADC-1036)

The problem of low-level counting is considered from the viewpoint of minimizing the statistical error for a given counting time. Explicit equations are derived for the comparison of counting methods giving different sample-to-background ratios when both sample and background rates are considered as variables. Experimental results are given for the improvement of $C^{14}O_2$-filled proportional counter measurements using a pulse-height discrimination method. A reduction of counting time by a factor of three was obtained for a representative case. (auth)

5786

Argonne National Lab.

[MEASURING TECHNIQUES], p.25-7, 126-39 of QUARTERLY REPORT NOVEMBER, DECEMBER 1950 AND JANUARY 1951; DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; Austin M. Brues, Director. [nd] 17p. (ANL-4571(p.25-7, 126-39))

Initial studies with the mass spectrometer reveal that it is possible to calculate the molecular weights of permanent gases with an accuracy of about 1%. This suggests the possibility of identifying unknown components in a gaseous mixture, even if the mass spectrum of the component is not known, and the general procedure may be useful in fundamental studies of gas kinetics. Investigations have been continued to develop the ionization type halide detector into a stable quantitative instrument. The dependence of the ion current upon the composition and rate of flow of the gas being used, the temperature of the detector, the collecting potential, and the condition of the electrodes are reported. A review of the literature pertinent to the use of photographic x-ray films and nuclear emulsions in monitoring a neutron flux has been completed and includes a listing of elements that may be tried in the study of the (n,γ) reaction as applied to personnel monitoring.

5787

Brookhaven National Lab.

PERFORMANCE OF 5819 PHOTOMULTIPLIERS IN SCINTILLATION SPECTROMETERS. A. W. Schardt and William Bernstein. [nd] 1p. (AECU-1595)

The report is reproduced here in its entirety.

Three dozen 5819 photomultipliers have been tested for resolution with a 1/2 in. cube NaI-Tl crystal permanently mounted in an aluminized reflector with a quartz window. The full width at half maximum of the photoline of 670-kev quanta varied between 9 and 16% with most tubes ~12%. For 22 kev the extremes are 35 to 60% with most tubes near 45%. An attempt was made to correlate these results with some of the photomultiplier characteristics such as quantum efficiency, gain, uniformity, noise, dynode voltages, and electron collection efficiency. If the voltage between photocathode and first dynode is above 200 v no quantitative correlation could be found. However, tubes with high cathode sensitivity have in general a better resolution.

5788

New York Univ.

FLUORESCENCE AND CONDUCTIVITY PHENOMENA; PROGRESS REPORT NO. 4 COVERING PERIOD JANUARY 1, 1950, TO JANUARY 31, 1951. Hartmut Kallmann. May 1951. 66p. (NP-3171)

Separate abstracts have been prepared for the following sections of this report: Fluorescence of Organic Solutions, p.6-49; and Time Constant and Amplitude Measurements of Scintillation Pulses, p.50-66.

5789

ELECTRON COMPONENT IN GEIGER DISCHARGE. G. G. Kelley, W. H. Jordan, and P. R. Bell. Rev. Sci. Instruments 21, 330-2(1950) Apr.

Observation of the wave form of current during a Geiger discharge indicates the presence of a component due to electron collection amounting to as much as 50% of the total energy involved in the discharge. It appears, therefore, that the initial ion sheath can have a mean radius of the order of 10 to 15 times the radius of the center wire. Apparatus is described, wave forms are shown, and the method used to evaluate electron component and mean

radius of ion sheath is indicated. Results for two tubes with different quenching vapors are tabulated. (auth)

5790

ABNORMALLY LARGE PULSES IN COUNTERS FILLED WITH VAPORS. Ewald Fünfer and Hugo Neuert. Z. Physik 128, 530-7(1950) Nov. 16. (In German)

Pulses from α particles in counters filled exclusively or predominantly with vapors reveal charges that are much larger than those normally observed with proportional or Geiger-Mueller counters; this phenomenon is especially notable when the particles penetrate the counter radially. An oscillographic examination of the pulses showed that the discharges belong to a special, not yet observed, type. Although generated primarily during the restricted-proportionality stage, these pulses form also during the Geiger-Mueller stage. As found from propagation experiments, the discharges are limited to the neighborhood of the point of origin of the primary radiation, differing in this respect from the behavior of the ordinary Geiger-Mueller pulses. It seems possible to explain these phenomena by taking into account the hypothesis of the channel structure of spark discharges, as developed by Raether (Z. Physik 110, 611(1938)) and by Loeb and Meek (J. Applied Phys. 11, 459(1940)). (auth)

5791

THE SCINTILLATION COUNTER. W. Hanle. Naturwissenschaften 38, 176-85(1951) Apr. (In German)

A survey of literature on scintillation counters is given. 156 references.

5792

STANDARD DOSIMETRY AND RADIOLOGICAL UNITS. Robert Jaeger. Strahlentherapie 84, 581-6(1951). (In German)

A standard apparatus for the absolute measurement of the r has recently been established in Ockstadt, near Frankfurt-on-the-Main, Germany. The definition of the r will be maintained for the generally employed hardness range, and it could probably be extended to α and β rays. No unique numerical value can be attached to the "tissue-dose"; it is proposed to express the latter in erg/g. (auth)

5793

USE OF COUNTERS TRACERLAB TGC3 AND NUCLEOMETER RCL-CHICAGO FOR THE MEASUREMENT OF K RADIATIONS. Jean Govaerts. Bull. soc. roy. sci. Liège 20, 167-73(1951) Mar. (In French)

A comparison was made of sensitivities of some A-filled Geiger counters employed in measuring x rays that are emitted during K captures.

5794

FORMATION OF CLOUD DROPS IN THE WILSON CHAMBER. Erich Bagge, Friedrich Becker, and Günther Bekow. Z. angew. Physik 3, 201-9(1951) May 18. (In German)

Kinetographic observations on the speed of formation of droplets in the cloud chamber showed that in the so-called "slow" chambers a condensation requires, under certain conditions, an abnormally long time, up to 0.2 sec. A theoretical study pointed to the increase in the temperature of the droplet, which occurs during the condensation, as the cause of those long growth periods. Depending on working conditions, the temperature increase is about 10 to 20°. A formula describing the growth is derived, which, among other applications, permits an approximate calculation of droplet sizes smaller than the free path of the gas molecule. (auth)

5795

DIRECTIONAL PROPERTIES OF SINGLE CRYSTAL OF ANTHRACENE REGARDING FLUORESCENCE PHENOMENA. S. C. Ganguly and N. K. Chaudhuri. J. Chem. Phys. 19, 617-18(1951) May.

The polarization of fluorescent radiation of a single crystal of anthracene has been measured and this measurement has been utilized to determine the nature and orientation of oscillators. From this measurement it has been found that the oscillators are linear oscillators and their direction is independent of the direction of the electric vector of the incident light vibration. They make an angle of 33° with the b axis of the crystal. (auth)

5796

THE USE OF THE GEIGER-MÜLLER COUNTER X-RAY SPECTROMETER IN AN X-RAY LABORATORY, WITH SPECIAL REFERENCE TO AUTOMATIC RECORDING. C. Wainwright. Brit. J. Applied Phys. 2, 157-63(1951) June.

The advantages and limitations of G-M counter techniques in a laboratory applying x-ray methods to metallurgical problems are discussed, and some simple examples are described. Semiquantitative results are obtained rapidly by G-M counter x-ray spectrometer estimation of x-ray diffraction intensities, and there is a very considerable advantage to be gained if there is involved the measurement of intensity or some other property of a single x-ray line or of several lines. The accuracy of the method is considered in relation to the statistical effects associated with the operation of the Geiger counter and the influence of damping in the recording system.

5797

A DIVIDED LIGHT GUIDE FOR COINCIDENCE COUNTING OF SCINTILLATIONS DUE TO ALPHA PARTICLES. Boleslaw Makiej. J. Sci. Instruments 28, 188-9(1951) June. (Laboratory and workshop notes)

In order to dispense with the use of a proportional counter and its associated thin window in connection with a magnetic spectrometer a scintillation detector was devised. Important restrictions on the design of the instrument were that the background must be extremely low, less than 1 cpm, and the instrument must be operated near the magnet. A coincidence method, with two photomultipliers receiving light from the same crystal, greatly reduced background arising in the photomultipliers. For the preliminary experiment a forked light guide was constructed from 0.5-in. diam Perspex rod, cemented at the junction with chloroform and coated on the previously polished end with a screen of zinc sulfide/silver of about 8 mg/cm^2, bound with a mixture of Durofix and amyl acetate. A constant high efficiency for counting α particles was found over the range 0.9 to 3.4 Mev. 1 diagram. 2 graphs.

5798

ALPHA-PARTICLE RANGE-ENERGY CURVE FOR KODAK NTA EMULSIONS. F. E. Steigert, E. C. Toops, and M. B. Sampson. Phys. Rev. 83, 474(1951) July 15. (Letter to the editor)

A modified range-energy curve has been derived for α particles in Kodak NTA emulsions. The agreement of the calculated curve with experimental data is good, and accurate measurement of tracks is extended to 14.9 Mev. The curve rise is less steep than that of Ilford B1 emulsion reported by Lattes, Fowler, and Cuer (Proc. Phys. Soc. (London) 59, 883(1947)).

5799

BEHAVIOR OF SPACE CHARGE IN DIAMOND CRYSTAL COUNTERS UNDER ILLUMINATION. A. G. Chynoweth. Phys. Rev. 83, 254-63(1951) July 15.

The development of a technique is described whereby alternate electric field pulses and white light flashes are used to overcome the difficulty of the formation of space charge in a diamond crystal counter when subjected to bombardment by β-particles. Using the method, a study

is made of the behavior of the space charge field when the electric field strength and flash intensity are varied. The manner in which the space charge grows and decays with time depending on the conditions of the experiment is described. It is shown how, under suitable conditions, steady counting-rates can be obtained and, in particular, how the behavior of the counter under space-charge free conditions can be investigated. Qualitative results are also given concerning the effect of illumination of the counter with red and infrared light instead of white light.

Preliminary experiments on the effect of temperature on the counter suggest the possibility of permanently preventing the formation of space charge by keeping the temperature of the counter sufficiently high. It is also indicated how experiments at different temperatures could yield information concerning the distribution of trap depths in the crystal and the mean lifetimes of trapped electrons and holes.

A new approach to the problems of solid-state physics has thus been developed. The great advantage that it possesses over luminescence methods is that it does not require the emission of light in order to study the electron transitions between trapping states and the ground state and, consequently, radiationless transitions can be investigated. (auth)

5800
ON MEASURING VERY SHORT HALF LIVES. Z. Bay, R. R. Meijer, and G. Papp. Phys. Rev. 82, 754-5(1951) June 1. (Letter to the editor)

The counting rate vs. delay curve obtained using a differential coincidence counting method (Bay, Bull. Am. Phys. Soc. 26, No. 3, 51(1951)) provides a means for measuring very short half lives without changing the artificial time delays in the equipment during the measurement. Preliminary results of experiments in progress (not described) indicate that half lives as short as 10^{-10} sec can be measured.

5801
MEASUREMENT OF GEIGER COUNTER PLATEAU SLOPE. D. E. Hull. Rev. Sci. Instruments 22, 338(1951) May. (Laboratory and shop notes)

Numerical values of the plateau slope measured with G-M counters filled with infinite-life gases have been found to vary greatly with different positions of the radioactive source relative to the counter. The smallest slope (11%/100 v) was obtained with the source attached to the counter tube near the middle. It is suggested that the plateau slope should be specified by the tube maker in terms of measurement in a uniform radiation, i.e., by placing the source at least one counter length away.

5802
FACTORS INVOLVED IN THE ACCURACY AND REPRODUCIBILITY OF DEPTH MEASUREMENTS ON NUCLEAR RESEARCH EMULSIONS. J. M. McAlister and D. W. Keam. Proc. Phys. Soc. (London) 64A, 91-2(1951) Jan. (Letter to the editor)

Factors which may be responsible for considerable variations in the apparent thicknesses of processed emulsions have been investigated. The factors considered were (1) reliability of the measuring instrument, (2) variation of emulsion thickness with relative humidity, and (3) effect of oil immersion on the emulsion. It was found that humidity has a large effect upon thickness, and therefore it is necessary to work at a constant humidity. Inconclusive results also indicate that it is advisable to remove oil from the plates as soon as measurements are finished.

5803
THE FLUORESCENCE EFFICIENCIES OF SOME CRYSTALS FOR ELECTRONS AND HEAVY PARTICLES. W. K. Jentschke, F. S. Eby, C. J. Taylor, M. E. Remley, and P. G. Kruger. Phys. Rev. 83, 170-1(1951) July 1. (Letter to the editor)

The fluorescence efficiency of anthracene, stilbene, and Tl-activated NaI crystals to monoenergetic electrons as compared to heavy particles with the same specific energy loss has been investigated. A cathode-ray gun furnished electrons with energies of 500 to 5000 ev, and internal-conversion electrons with energies from 27 to 624 kev were used to extend the data. Curves of pulse height vs. energy are given. Responses of the anthracene crystal to different ionizing radiation are compared by considering the variation of the specific fluorescence with the specific energy loss.

5804
RESPONSE OF SOME SCINTILLATION CRYSTALS TO HEAVY PARTICLES. C. J. Taylor, M. E. Remley, W. K. Jentschke, and P. G. Kruger. Phys. Rev. 83, 169-70(1951) July 1. (Letter to the editor)

The response of anthracene, stilbene, and Tl-activated NaI crystals to protons of 1 to 5 Mev, deuterons and molecular H ions of 1 to 11 Mev, α particles of 4 to 21 Mev, and Po α particles has been investigated. Graphs of pulse height vs. energy show a distinct difference in the behavior of the organic crystals and NaI. The organic crystals have a nonlinear response of pulse height to energy in the entire region investigated. In NaI, protons and deuterons give linear response, while α particles show a nonlinear relation over a low-energy region with a linear response above an energy of about 10 Mev. A detailed analysis has shown the nonlinearity of NaI to be dependent on the ionization density produced by the incident particle.

5805
ADDITION OF SPECIFIED ELEMENTS TO LIQUID COUNTERS. Stirling A. Colgate. Rev. Sci. Instruments 22, 346(1951) May. (Laboratory and shop notes)

An investigation has been made of the possibility of adding high atomic number elements to liquid scintillation counters in order to increase their γ-ray stopping power. This objective was not attained. However, the information gained as to the quenching effects of additions to liquid counters is reported. It is also suggested that it is possible to construct a heterogeneous liquid counter of high γ-ray stopping power composed of multiple thin-glass plates separated by counter liquid.

5806
THE GAS-FILLING AND SOME CHARACTERISTICS OF BROMINE-QUENCHED GEIGER-MÜLLER COUNTERS. D. H. Le Croissette and J. Yarwood. J. Sci. Instruments 28, 225-8(1951) Aug.

The preparation of G-M counters containing bromine as a quenching gas in a filling of neon and/or argon is described with particular attention paid to ensuring that the partial gas pressures are determined accurately. An empirical law relating the threshold voltage and the partial pressure of bromine is obtained. The true function of a small percentage of argon in a neon-bromine counter as regards its effect on the length of the plateau is considered.

Some new data appear on the oscillations produced by these counters. (auth)

5807
A DIRECT READING METER FOR THE MEASUREMENT OF HIGHLY ACTIVE SAMPLES OF GAMMA-EMITTING RADIOISOTOPES. W. K. Sinclair and S. P. Newbery. J. Sci. Instruments 28, 234-7(1951) Aug.

A direct reading meter for the measurement of highly active samples of gamma emitting radioisotopes is described. It incorporates an ionization chamber and a d-c amplifier. The source is placed within the chamber annulus

and the operator is protected from it by 4 cm of lead. The instrument has been calibrated for a number of gamma emitting isotopes and samples ranging from 2 mg to more than 2000 mg radium equivalent may be quickly and safely measured. (auth)

5808

CONTINUOUS PURIFICATION OF HYDROGEN IN A LARGE ELECTRON-PULSE CHAMBER. W. N. English. Rev. Sci. Instruments 22, 598-600(1951) Aug.

A hot uranium purifier for hydrogen (or deuterium) has been constructed which will remove relatively large amounts of negative ion forming impurities such as O_2, Cl_2, H_2O, thus permitting electron pulse collection without any elaborate outgassing procedure. The method has been tested at 6 atmospheres hydrogen pressure by observing the pulse distribution from a Pu^{239} α-source in the chamber and plotting the "most-probable-pulse-amplitude" against purifying time. A "purifying time constant" of about two days was obtained. (auth)

5809

ANALYSIS OF HIGH ENERGY PROTON SPECTRA BY MEANS OF A STACK OF PHOTOGRAPHIC PLATES. Darcy Walker. Rev. Sci. Instruments 22, 607-11(1951) Aug.

Stacks of photographic plates have been used to analyze the continuous spectrum of high energy protons emitted by a carbon target bombarded with γ rays from an electron synchrotron. The planes of successive plates in a stack lay at 30° to a line through plate and target centers, and the plates were interleaved with aluminum absorbers. The numbers of proton tracks per square cm in the emulsions of successive plates yield an integral spectrum of the protons. Protons with energies up to more than 120 Mev were present when the synchrotron was operated at 195 Mev. The effects of multiple scattering of the protons in the stacks are discussed, and it is shown how the tracks of protons originating from the target can be distinguished clearly from a background of randomly oriented tracks. (auth)

5810

PART V. THE CHALK RIVER PULSE AMPLITUDE ANALYZER. N. F. Moody, W. J. Battell, W. D. Howell, and R. H. Taplin. Rev. Sci. Instruments. 22, 555-63(1951) Aug.

This paper describes the pulse amplitude analyzer designed and now in use at the National Research Laboratories, Chalk River, Canada. The key features include analysis at a 200-v pulse level, yielding a channel setting accuracy better than 0.1 v or (1/2000 in terms of the maximum energy). The electronic resolving time is of the order of 10 μsec, and pulses whose wave fronts range from ⅓ to 1000 v μsec are accepted without pretreatment or the need for adjustment. Six analyzing channels, based on the use of National Research Council's counting subunits, are contained in a cabinet and constitute a complete six-channel instrument. Interconnection of cabinets by four cables allows as many as 60 channels to be employed for a single analysis. Great attention has been given in the design to the operational aspects of reliability, stability, and flexibility of application. (auth)

5811

CALORIMETRIC DETERMINATION OF THE ENERGY FLUX OF 22.5-MEV X-RAYS. J. S. Laughlin and J. W. Beattie. Rev. Sci. Instruments 22, 572-4(1951) Aug.

A sensitive method of calorimetrically measuring the energy flux of an x-ray beam is described. Thermistors are employed as the temperature-sensitive elements and are embedded in the irradiated material in a calorimeter. Details and results of the application of this technique to a betatron x-ray beam are described. This method can be applied to x-ray beams of other energies and does not require high intensities. (auth)

5812

A SCINTILLATION COUNTER FOR THE RELATIVE DETERMINATION OF X-RAY INTENSITIES IN RADIOLOGICAL WORK. Michel Ter-Pogossian and William B. Ittner III. Rev. Sci. Instruments 22, 646-8(1951) Aug.

An instrument is described for determining accurately the intensity of an x-radiation by direct reading. This instrument consists of a small potassium iodide crystal which fluoresces under the action of high energy photons. The light thus emitted is "piped" by means of a Lucite rod to a photomultiplier tube. The current generated in the tube is measured by a microammeter. A series of tests on the energy dependence of this detector are reported. It is concluded that the instrument described is suitable for the determination of isodose charts. (auth)

5813

ACHIEVEMENT IN RADIATION DOSIMETRY, 1937-1950. Edith H. Quimby. Brit. J. Radiology 24, 2-5(1951) Jan.

The theoretical and practical lines along which developments in radiation dosimetry have been proceeding, the relation between energy-absorption and ionization methods, the question of a biological dose unit, the use of extrapolation chambers in phantoms, and necessary lines of research are discussed briefly.

5814

THREE-CRYSTAL SCINTILLATION SPECTROMETER. Joe Keagy Bair and Fred C. Maienschein. Rev. Sci. Instruments 22, 343-4(1951) May. (Laboratory and shop notes)

A three-crystal scintillation spectrometer, which will measure γ-ray energies by pair production in addition to operating as a Compton spectrometer, has been constructed. It can be made to give very high counting efficiencies, since large crystals can be used quite close together in order to obtain large solid angles. No collimation is necessary. The reduction (about 50%) in the pair peaks when one crystal is in anticoincidence with the other two can be of value in analyzing spectral data in the region where both pair and Compton peaks are obtained.

5815

A SCINTILLATION COUNTER FOR THERMAL NEUTRONS. James E. Draper. Rev. Sci. Instruments 22, 543(1951) July.

Two scintillation counters, both used in conjunction with the RCA 5819 photomultiplier, are described. The first was a thin layer of powdered B_2O_3 immersed in a terphenyl/toluene "counting liquid." The second used LiI(Tl) crystals grown in a sealed, evacuated pyrex tube lowered slowly through a Strockbarger furnace. In both cases the efficiency for detecting thermal neutrons was approximately that calculated, viz., about half of all thermals crossing the counting volume (as determined by In foil activation) were detected when a counter thickness of one neutron mean free path is used.

5816

THE $^{12}C(n, 2n)^{11}C$ REACTION IN AN ANTHRACENE CRYSTAL. J. Sharpe and G. H. Stafford. Proc. Phys. Soc. (London) 64A, 211-12(1951) Feb. (Letter to the editor)

Report is made of the methods used at the AERE at Harwell to ascertain whether the neutron flux is below the biological tolerance level. For neutrons of energy greater than 20.4 Mev this has been carried out satisfactorily by the use of the $C^{12}(n, 2n)C^{11}$ reaction, the threshold for which occurs at the above neutron energy. The C^{11} decays with a half life of 20.35 ± 0.08 min, emitting a positron of maximum energy 0.97 Mev. High sensitivity has been achieved by irradiating an anthracene crystal and counting, with an E.M.I. photomultiplier tube, the scintillations produced in the crystal itself by the positrons from the decaying C^{11}

nuclei. It is possible to detect a neutron flux of 15 neutrons/cm²/sec by this method. The technique also provides an interesting example of the use of a scintillation counter for the study of a beta-ray spectrum.

5817
A NEW TYPE OF HIGH SPEED COINCIDENCE CIRCUIT. Z. Bay. Rev. Sci. Instruments 22, 397-400(1951) June.

A new coincidence device using crystal diodes has been developed. The new circuit does not necessitate equalizing and can be used for pulses with an amplitude spread of two orders of magnitude. The principle of the new circuit is to compare two measurements: one made in one of the channels, and the other made between the two channels. Resolving times down to 3×10^{-10} sec have been obtained, which represent an improvement of one order of magnitude over former circuits. The improvement in the sensitivity also turned out to be about one order of magnitude. The new circuit should be useful in nuclear experiments in determining decay times, disintegration rates, and for the reduction of noise in scintillation counters. (auth)

5818
CLOUDS PRODUCED IN AN EXPANSION CHAMBER BY ULTRA-VIOLET LIGHT. F. J. M. Farley. Proc. Roy. Soc. (London) 207A, 527-39(1951) July 23.

Clouds are produced in an expansion chamber filled with air and water vapor by irradiating with ultraviolet light through a quartz window, and expanding shortly afterwards. It is shown that the condensation does not occur upon charged particles, but on certain electrically neutral nuclei, not yet identified. By varying the wavelength of the ultraviolet light it is shown that the condensation is initiated by atomic oxygen, liberated by the action of the radiation on oxygen molecules. Similar effects are produced when an intense beam of deuterons is passed into the chamber. (auth)

5819
COINCIDENCE METHODS OF MEASURING DISINTEGRATION RATES OF RADIOACTIVE SOURCES. J. Barnothy and M. Forro. Rev. Sci. Instruments 22, 415-23(1951) June.

Errors involved in the coincidence methods of measuring disintegration rates of radioactive sources are discussed and means to avoid or to evaluate them are given. The disintegration rate of Co^{60} γ-ray standard of the National Bureau of Standards is determined experimentally. (auth)

MESONS

5820
Radiation Lab., Univ. of Calif.
THE SCATTERING OF π-MESONS BY DEUTERONS. S. Fernbach, T. A. Green, and K. M. Watson. Aug. 10, 1951. 27p. (UCRL-1443)

A study has been made of the expected properties of the cross section for scattering π-mesons by deuterons on the basis of the impulse approximation. The cross section for high-energy mesons is expressed in terms of the cross sections for meson scattering by free protons and neutrons. This provides a means of deducing the latter when the deuteron and proton cross sections are known. (auth)

5821
Radiation Lab., Univ. of Calif.
FURTHER EVIDENCE CONCERNING THE REACTION $P + P \rightarrow D + \pi^+$. V. Peterson, E. Iloff, and D. Sherman. June 5, 1951. 7p. (UCRL-1405)

The energy spectrum of π^+ mesons has been observed at angles of 18, 30, and 64° using a "point" source of liquid H bombarded with nearly monoenergetic protons. The peak meson energy (18°) of 63.5 ± 0.3 Mev and incident proton energy (342 ± 1 Mev) have been used to calculate a mass value for the π^+ meson of 279.0 ± 1.5 m_e. The relative cross sections as a function of laboratory angle are plotted. The angular distributions to be expected from pure isotropic or $\cos^2\theta$ production are shown for the case $p + p \rightarrow d + \pi^+$.

5822
DISINTEGRATIONS PRODUCED BY THE NUCLEAR CAPTURE OF SLOW NEGATIVE μ-MESONS. E. P. George and J. Evans. Proc. Phys. Soc. (London) 64A, 193-8(1951) Feb.

The "prong distribution" for the disintegrations produced by the σ mesons of the cosmic radiation in photographic emulsions exposed below ground is found to be different from that observed in emulsions exposed above ground. The underground distribution contains relatively more "stars" consisting of one prong. The observations are consistent with the hypothesis that most of the σ mesons below ground are in fact negative μ mesons and not negative π mesons. It is concluded that 8.7 ± 1.7% of the negative μ mesons captured in the emulsion lead to disintegrations accompanied by the emission of charged particles. The average number of prongs per disintegration produced by the capture of negative μ mesons is 0.10 ± 0.02. The mean number of prongs and the associated prong distribution suggest that a nuclear excitation of about 15 Mev is produced by the capture of a μ meson. (auth)

5823
GENERATION OF MESONS FROM γ QUANTA. A. M. Baldin and V. V. Mikhaĭlov. Uspekhi Fiz. Nauk 44, 200-37(1951) June. (In Russian)

Experimental and theoretical works on the generation of mesons from photons are reviewed. 27 references.

5824
THE FAST PROTONS IN π^--MESON STARS. Y. Fujimoto, K. Takayanagi, and Y. Yamaguchi. Progress Theoret. Phys. (Japan) 5, 498-500(1950) May-June. (Letter to the editor)

The theoretical energy distribution of fast protons escaping from the nucleus as a result of π-meson capture is discussed briefly.

5825
CROSS SECTION FOR PRODUCTION OF CHARGED π-MESONS IN C AND H AT 90° TO A 381-MEV PROTON BEAM. M. M. Block, S. Passman, and W. W. Havens, Jr. Phys. Rev. 83, 167(1951) July 1. (Letter to the editor)

A method for measuring the absolute differential production cross section for charged π mesons has been devised, utilizing the internal 381-Mev proton beam of the Nevis cyclotron. Ilford C2 nuclear emulsions, imbedded in tapered Cu and Al absorbers, were placed inside the vacuum chamber, 2½ in. below the carbon target. The π^+ cross section, integrated over meson energy, $d\sigma^+/d\omega$, is $(5.2 \pm 1.3) \times 10^{-30}$ cm²/steradian/carbon nucleus, and the integrated π^- cross section is given by $d\sigma^-/d\omega = (4.6 \pm 1.9) \times 10^{-29}$ cm²/steradian/carbon nucleus. The ratio of the two integrals $(d\sigma^+/d\omega)/(d\sigma^-/d\omega) = 11 \pm 3$. A preliminary cross section at 90° for the production of positive mesons by protons in H_2 was found to be $d\sigma(90°)/d\omega = (5.0 \pm 1.2) \times 10^{-39}$ cm²/steradian by using a polyethylene target and subtracting the C contribution.

5826
GENERATION OF PHOTONS DURING COLLISIONS OF NUCLEONS. Reinhard Oehme. Z. Physik 129, 573-610 (1951) May 17. (In German)

In the frame of Heisenberg's theory of meson generation, the spectrum of photons formed from the decay of neutral mesons that are generated during collisions between nucleons is calculated both for a decay into two quanta and for a disintegration of a particle of spin 1 into 3 photons. The experimental results obtained for medium values of collision energies show that only the process $\pi^0 \rightarrow 2\gamma$ is possible and, consequently, that the spin of the π^0 meson is equal to 0. The spectrum of decay photons in

the outer layers of the atmosphere is computed and compared with the measured energy distribution; as a result, an exponential decrease in the differential spectrum is found, the exponent measuring the intensity of the nonlinear interaction of mesons in the wave packet formed during the collision. Radiations due to other photon-generating processes are considered, viz., the radiation from created charged mesons, and the bremsstrahlung of the nucleons; for collisions of very high energy, giving rise to extensive atmospheric showers, the photon yield in both processes depends on the spin assigned to charged π mesons; the yield is larger for spin 1 than for spin 0. (auth)

5827

ON THE CROSS SECTION FOR PHOTOMESON PRODUCTION. Gentaro Araki. Phys. Rev. 82, 959-60(1951) June 15. (Letter to the editor)

The differential cross section for positive-meson production by photons incident on a proton at rest, as calculated by scalar and pseudoscalar theory, is compared with experimental values obtained by Bishop et al. (Phys. Rev. 80, 291(1950)).

5828

π^+ MESON MASS DETERMINATION. W. F. Cartwright. Phys. Rev. 82, 460-1(1951) May 1. (Letter to the editor)

The high peak in the meson spectrum, at maximum meson energy, for production by proton-proton interaction, provides a method for measuring the π^+ meson mass. It is concluded that meson production at maximum meson energy is accompanied by formation of a deuteron. The π^+ meson mass, as determined by this experiment, is $275.1 \pm 2.5\ m_e$.

5829

ANALYSIS OF CHARGED MESON PRODUCTION BY PROTONS. S. Passman, M. M. Block, and W. W. Havens, Jr. Phys. Rev. 83, 167-8(1951) July 1. (Letter to the editor)

Results of experiments by the authors at Columbia and by others at Berkeley are used to calculate the total π^+-meson production cross section in H_2 at 343 Mev as $(2.9 \pm 0.4) \times 10^{-28}\ cm^2$. Assumptions made in calculating π^+-meson differential production cross sections from a heavy nucleus are enumerated. Graphs of differential cross section vs. meson energy compare experimental values for C with theoretical results calculated under different assumptions. Analysis of π^+-meson production by protons in H_2 and in C suggests that the matrix elements for this process are linearly proportional to the meson momentum and that the meson receives approximately the maximum available kinetic energy in the center-of-mass system.

NUCLEAR PHYSICS

5830

Carnegie Inst. of Tech.

THE PAIRING EFFECT IN NUCLEI AND THE BETA-LABILE ELEMENTS; by Truman P. Kohman. Aug. 24, 1951. 9p. (NYO-712)

It has been shown previously (Glueckauf, Proc. Phys. Soc. (London) 61, 25(1948)) that in certain regions of nuclides the pairing energy of protons exceeds that of neutrons. Statistical examination of the β-stable odd-mass nuclides shows that this situation is probably fairly general except for light elements. Theoretical explanations in terms of the exclusion principle, electromagnetic interaction, and overlap effect are suggested. The bearing of the pairing effect on the β lability of Tc and Pm and the possible β lability of In is discussed.

5831

Oak Ridge National Lab.

TABLES OF COEFFICIENTS FOR INTERNAL CONVERSION ANGULAR CORRELATIONS; by M. E. Rose, L. C. Biedenharn, and G. B. Arfken. Issue date Sept. 20, 1951. 17p. (ORNL-1097)

The angular correlation function, $W(\theta)$, in a double cascade in which one or both transitions involve the emission of a conversion electron is obtained from the γ-γ correlation function by insertion of appropriate coefficients in the Legendre polynomial expansion of $W(\theta)$. Tables of coefficients and formulas are given for computing $\gamma - x$, $\gamma - e$, $e - e$, and $\alpha - e$ correlation functions for Z from 10 to 96, for transition energies in the range 0.3 to 5.0 mc^2, and for the first five electric and first five magnetic multipoles.

5832

Atomic Energy Research Establishment, Harwell, Berks (England)

STUDIES IN jj-COUPLING; I. CLASSIFICATION OF NUCLEAR AND ATOMIC STATES. B. H. Flowers. May 23, 1951. 19p. (AERE-T/R-713)

A study has been made of the allowed terms and energies of systems of many equivalent particles in jj-coupling for various types of two-body interaction. The methods of group theory are employed to enumerate and classify the states of the nuclear configuration $(l_j)^n$. Classification of states according to the irreducible representations of groups of linear transformations leads to the introduction of certain quantum numbers which then characterize the states. Invariance under the group of unitary transformations in the space of the $2j + 1$ individual-particle functions introduces the isotopic spin, while invariance under the subgroup of symplectic transformations introduces the concepts of seniority and reduced isotopic spin. The complete classification and enumeration of the states of the nuclear configurations j^n, carried through for $j = \frac{3}{2}$, $\frac{5}{2}$, and $\frac{7}{2}$, is presented. The states of the corresponding atomic configurations are included, these being states of maximum isotopic spin. As a result of the classification, certain degeneracies observed in the energy matrix of the electrostatic interaction in jj-coupling are shown to be intimately connected with the properties of the symplectic groups. The spins of nuclear ground states are briefly discussed in the light of the jj-coupling shell-model. 23 references. (auth)

5833

Technical Information Service, AEC

NUCLEAR SCIENCE IN ENGINEERING EDUCATION; A SELECTED LIST OF REFERENCES FOR INSTRUCTORS. [nd] 17p. (TID-3011)

This bibliography lists material on nuclear science which may be of interest to instructors in engineering schools. It includes reports of the United States Atomic Energy Commission and its contractors, journal literature, textbooks, and reference books. The headings under which references are listed include elementary nuclear science, reactor theory, reactor technology, reactor construction materials, power from nuclear reactors, heat transfer, separation processes, radiation detection and protection, and radioactive waste and chemical processing.

5834

Institute for Nuclear Studies, Univ. of Chicago

RESEARCH PROGRAM WITH THE CHICAGO CYCLOTRON; PROGRESS REPORT; AUGUST 1, 1949, TO AUGUST 1, 1950. [nd] 99p. (NP-3182)

Separate abstracts have been prepared for the following sections of this report: Hot Atom Chemistry of Bromine in Organic Systems; Part I, sect.1, p.1-6; and On the "Positive Particles" Appearing Near Beta-Ray Emitters; Part II, sect.10, p.56-84. The remainder of the report consists of reprints of several articles in Physical Review and papers which have since been published in that journal.

5835
GROUND STATE OF DEUTERON ACCORDING TO PSEUDOSCALAR MESON THEORY. G. Araki and Y. Mori. Progress Theoret. Phys. (Japan) 5, 505-6(1950) May-June. (Letter to the editor)

Results obtained on the calculation of the ground state of the deuteron according to symmetrical pseudoscalar meson theory are reported briefly.

5836
ft-VALUES OF β DECAY AND THE SHELL MODELS. M. Taketani, S. Nakamura, M. Umezawa, K. Ono, and Y. Yamaguchi. Phys. Rev. 82, 441-2(1951) May 1. (Letter to the editor)

The β-decay schemes and selection rules of β rays have been analyzed by Mayer's shell model (Phys. Rev. 78, 16(1950)). Conclusions agree with those of Feenberg and Trigg (Revs. Modern Phys. 22, 399(1950)).

5837
THE SPLITTING OF *l*-SHELLS IN HEAVY NUCLEI BY THE TENSOR INTERACTION. Julian Keilson. Phys. Rev. 82, 759(1951) June 1. (Letter to the editor)

To explain the nuclear "magic numbers," a strong spin-orbit interaction favoring single-particle states of total angular momentum $j = l + \frac{1}{2}$ is needed. A study has been made of the contribution to this splitting of a tensor interaction between an outer particle and the particles of a spherically symmetrical spin-saturated core, regarded as moving independently in the states Ψ_l of a spherical potential well.

5838
NUCLEAR COMPRESSIBILITY AND FISSION. W. J. Swiatecki. Phys. Rev. 83, 178-9(1951) July 1. (Letter to the editor)

Effects of nuclear compressibility and polarizability of nuclear matter (separability of neutrons and protons) on asymmetry of nuclear division in fission are calculated. The calculations also indicate that the compressibility may have a considerable effect on the threshold energy.

5839
DIRECT PHOTODISINTEGRATION PROCESSES IN NUCLEI. Ernest D. Courant. Phys. Rev. 82, 703-9(1951) June 1.

The unexpectedly large (γ,p) cross sections found in many moderately heavy nuclei are interpreted in terms of a direct photodisintegration process. The γ-ray quantum is supposed to be absorbed by one proton in the nucleus, which is then emitted without the formation of an intermediate compound nucleus. The cross section for this process is small compared with that for the formation of a compound nucleus (which would almost always lead to the eventual emission of a neutron), but it has to be only a few millibarns to account for the experimental results. It is shown in this paper that if the nucleus is represented by a square-well potential, the calculated cross sections turn out to be smaller than the experimental ones, but much larger than those obtained from the statistical theory. The angular distribution of the emitted protons can be accounted for more easily by Feenberg's "wine bottle" potential (Feenberg and Hammack, Phys. Rev. 75, 1877(1949)) than by the square well. The theory is applicable to fast photoneutron emission as well, and recent experiments by Poss (Phys. Rev. 79, 539 (1950)) show that fast photoneutrons are indeed emitted anisotropically. It is suggested that similar direct interaction mechanisms may account for the deviations of (n,p) cross sections from those predicted by the theory, as found recently by Wäffler (Helv. Phys. Acta 23, 238(1950)). (auth)

5840
NEUTRON BINDING ENERGIES FROM (d,p) REACTIONS AND NUCLEAR SHELL STRUCTURE. J. A. Harvey. Phys. Rev. 81, 353-64(1951) Feb. 1.

Using 14-Mev deuterons, the author has measured proton spectra for many elements of heavy and medium atomic weight. The range of the protons was measured in Al foils by the method of "peaking" with a triple proportional counter. From the Q value of the ground-state proton group (measured relative to a Q value of 5.50 Mev for the Al ground-state group), the neutron binding energy of the residual nucleus has been obtained.

These values are compared to the maximum γ-ray energy obtained from thermal-neutron capture. A few neutron binding energies have been measured from the (d,t) reaction and are compared with values obtained from the (γ,n) threshold. Several neutron binding energies have been computed from radioactive decay energies and measured neutron binding energies. All neutron binding energies have been compared with the values predicted from the semiempirical mass formula. A sharp drop in neutron binding energy of about 2.2 Mev occurs at the completion of the closed shell of 126 neutrons. A drop, a little greater than 2 Mev, occurs at 50 neutrons. There is also a decrease in the region of 82 neutrons. There also seems to be a decrease of about 1 Mev in the region of 29 neutrons, but this is not very conclusive. The differential cross section of the ground-state peaks from even-Z, odd-A isotopes at forward angles are much smaller (by a factor of ~10) than the differential cross sections of the ground-state peaks from the same-Z but even-A isotopes. The ground-state peaks from Sn^{117} and Pb^{207}, however, are about 50% that of the even-A isotopes. (auth)

5841
ON THE ADDITION ENERGY FOR NEUTRONS IN THE $h_{11/2}$ SHELL. Allan C. G. Mitchell. Phys. Rev. 83, 183-4(1951) July 1. (Letter to the editor)

According to the nuclear shell model, the region of isomerism extending from N = 63 to N = 81 is explained by the competitive filling of the $s_{1/2}$, $d_{3/2}$, and $h_{11/2}$ shells. Information about Te, Xe, and Ba isomers is summarized. A graph of the $h_{11/2} - d_{3/2}$ energy difference as a function of mass number from A = 121 to A = 137 shows that the energy associated with the addition of neutrons to the $h_{11/2}$ state increases only slowly from N = 69 to N = 77. From N = 77 to N = 81 this energy increases rapidly as the shell becomes nearly filled. All points fall on a smooth curve with the exception of Xe^{135}, which falls a little high. The fact that the energy difference lies on a smooth curve when plotted against the mass number A apparently shows that the addition energy depends on the size of the nucleus and not just on the neutron number, N.

NUCLEAR PROPERTIES

5842
Los Alamos Scientific Lab.
MEASUREMENT OF THE CROSS SECTION FOR THE REACTION $T + T \rightarrow He^4 + 2n + 11.4$ MEV; by H. M. Agnew, W. T. Leland, H. V. Argo, R. W. Crews, A. Hemmendinger, W. E. Scott, and R. F. Taschek. [nd] Decl. Sept. 11, 1951. 5p. (AECD-3235; LADC-1035)

A measurement of the cross section for the reaction $T + T \rightarrow He^4 + 2n + 11.4$ Mev has been made, using the 2.5-Mev Los Alamos electrostatic generator. An analyzed beam of tritons was passed through a 1/20 mil Ni foil into a thin gaseous tritium target. The triton energy was varied from 40 kev to 2.22 Mev. The differential cross section in millibarns per steradian at 0° was found to increase as a function of the triton energy, being near 3 mb at 200 and near 16 mb at 2000 kev. The neutron spectrum from the reaction has been examined and, except for the presence of two rather broad peaks at 8.1 and 10.4 Mev, there seem to be equal numbers of neutrons per energy interval up to 11

Mev with few neutrons having an energy greater than 11.5 Mev.

5843

Radiation Lab., Univ. of Calif.

SUMMARY OF NEUTRON CROSS SECTION MEASUREMENTS FOR 14-MEV TO 280-MEV NEUTRONS. Roger H. Hildebrand, Donald A. Hicks, and Wesley H. Harker. May 15, 1951. 10p. (UCRL-1305)

Curves of cross section vs. energy for 12 representative elements and of cross section vs. atomic weight at 7 energies are given, from which the cross section of any element at any energy from 14 to 280 Mev may be estimated by interpolation. Most of the light-element cross sections may be found directly from the σ vs. E curves. A table is included for convenience in calculating half thicknesses for 92 elements, a second table gives information on attenuation of neutron beams in concrete, while a third gives ratios of inelastic to total cross sections for use in calculating poor-geometry attenuation.

5844

ON THE ISOTOPIC SHIFT IN THE Cu I RESONANCE LINES. Peter Brix and Walter Humbach. Z. Physik 128, 506-10(1950) Nov. 16. (In German)

Using the atom-beam absorption method described elsewhere (Brix and Steudel, Z. Physik 128, 260(1950)), the following hyperfine structures were measured: line Cu I λ 3274 A ($4s\ ^2S_{1/2} - 4p\ ^2P_{1/2}$): −31, 0, +388, +424; and line Cu I λ 3247 A ($4s\ ^2S_{1/2} - 4p\ ^2P$): 0, +370, ~ +405 ($\times 10^{-3}$ cm^{-1}). Components +424 and ~ +405, weaker than the others, are attributed to Cu^{65}. Assuming an analogy between the behavior of the hyperfine structure splittings of Cu isotopes and that of their magnetic nuclear moments, it is found that, for the ground state of Cu I, the total splittings are equal to +390 (Cu^{63}) and +418 (Cu^{65}), and, correspondingly, that the isotopic shift (relative to the $^2P_{1/2}$ term) is equal to $(-18 \pm 4) \times 10^{-3}$ cm^{-1}; the center of gravity of the term corresponding to Cu^{65} is the lower of the two. A comparison with large isotopic shifts in the transition $3d^9 4s^2\ ^2D - 3d^{10}4_p\ ^2P$, observed by Ritschl (Z. Physik 79, 1(1932)), shows that specific mass effects take place in Cu I, which are much larger than the normal effects due to the participation of the nucleus in the intra-atomic movements. (auth)

5845

SLOW NEUTRON CROSS-SECTIONS OF ZIRCONIUM AND HAFNIUM. P. A. Egelstaff and B. T. Taylor. Nature 167, 896-7(1951) June 2. (Letter to the editor)

The total neutron cross sections of samples of zirconia and hafnia have been measured between 0.05 and 10 ev using a crystal spectrometer, and between 0.003 and 0.1 ev using a mechanical time-of-flight spectrometer. The total cross section of zirconia plotted against neutron energy shows irregularities due to crystal diffraction effects between 0.004 and 0.07 ev. Between 0.07 and 10 ev the cross section has an approximately constant value of 14.6 ± 0.2 barns. The Zr scattering cross section is computed as 7.1 ± 0.3 barns. The total cross section of hafnia below 0.1 ev is plotted as a function of neutron time-of-flight. The absorption cross section of Hf is given as $(22.6 \pm 1.2)/\sqrt{E}$ barns and is 143 ± 8 barns at 0.025 ev. At energies above the 1/v absorption region, four resonance levels were found at 1.10 ± 0.05 ev (σ_0 = 3300 ± 200 barns, Γ = 0.12 ± 0.02 ev), 2.20 ± 0.08 ev (σ_0 = 3400 ± 200 barns, Γ = 0.17 ± 0.03 ev), ~5.6 ev, and ~ 7.6 ev. The contribution of 210 barns from the first two levels to the absorption cross section at 0.025 ev conflicts with measured values. A note added in proof states that further chemical analysis has shown that the values of the Hf cross section are systematically 6% too large because of over-correction for impurities.

5846

SPIN OF SODIUM-24. K. F. Smith. Nature 167, 942-3 (1951) June 9. (Letter to the editor)

An atomic-beam apparatus using magnetic resonance has been built and used for finding the spin of Na^{24}. The design is not discussed, but references are given to similar apparatus. The results of one run are shown. It is concluded that the spin of Na^{24} is 4.

5847

ANGULAR CORRELATIONS BETWEEN PROTON AND γ RAY AND SPINS OF THE FIRST EXCITED LEVELS OF Li^7, B^{11}, and O^{17}. Jacques Thirion. Compt. rend. 232, 2418-19 (1951) June 25. (In French)

Angular correlations were measured between the proton and the quantum emitted in the reactions $Li^6(d,p)Li^{7*}(\gamma)Li^7$, $B^{10}(d,p)B^{11*}(\gamma)B^{11}$, and $O^{16}(d,p)O^{17*}(\gamma)O^{17}$. The correlations being zero, it is concluded that the spin of the three excited nuclei is equal to ½.

5848

ON THE HYPERFINE STRUCTURE OF THE ROTATIONAL SPECTRA OF XYZ_3-TYPE MOLECULE, WHERE NUCLEI Z HAVE ELECTRIC QUADRUPOLE MOMENTS. Masataka Mizushima and Takashi Ito. J. Chem. Phys. 19, 739-44 (1951) June.

Hyperfine structure due to the electric quadrupole moments of nuclei is calculated for a special molecule of XYZ_3 type, where nucleus Z has a spin larger than 1/2, and nuclei X and Y have no electric quadrupole moments. The number of the hyperfine structural lines is calculated group-theoretically for the cases where I_1 = 1, 3/2, 2, 5/2, I_1 being the spin of nucleus Z. The theoretical spectra of the J = 0 − 1 transition are given for these cases. (auth)

5849

THE INTERMEDIATE SPIN-ORBIT COUPLING FOR LARGE ROTATIONAL QUANTUM NUMBER. W. A. Nierenberg. Phys. Rev. 82, 932-5(1951) June 15.

If a nucleus of spin one-half is cosine-coupled to the molecular rotation, its molecular beam spectrum can be predicted for all values of the magnetic field from the Zeeman to the Paschen-Back region with one, closed expression. This expression is valid for large values of rotational quantum number and small rotational g-factor and is averaged over a Boltzmann distribution of rotational states. The special case of spin one-half is simple because the symmetry permits cosine coupling only, and the energy levels are well known for this hamiltonian. A kind of correspondence principle can be developed for this example which does two things. It shows that the other nucleus in a diatomic molecule has little effect on the spectrum of the first because the coupling of the second nucleus due to the rotation. Second, it permits the extension of the calculation to nuclei of spins greater than one-half when the coupling is predominantly cosinelike. (auth)

5850

NUCLEAR MAGNETIC RESONANCE STUDY OF TRANSITIONS IN POLYMERS. L. V. Holroyd, R. S. Codrington, B. A. Mrowca, and E. Guth. J. Applied Phys. 22, 696-705 (1951) June.

Nuclear magnetic resonance absorption line widths have been studied for several high polymers. The proton line widths were studied in a field of 7000 gauss and at a frequency of about 30 Mc. Line widths obtained for Hevea and GR-S were very narrow, indicating a large degree of "quasi-free rotation" in these materials. Vulcanization, carbon loading, co-polymerization, and crystallization produced a broadening of the lines as expected from the hindrance to internal motion introduced by these factors. Line width transitions as a function of temperature were

observed for several polymers. Linear thermal expansion coefficients and specific heat vs. temperature curves have breaks in the region of line transitions for the polymers studied. Swelling of polymers with benzene produced a narrowing of the absorption line throughout the line transition and lowered the transition temperature. Vulcanization broadened the transition range and shifted it to higher temperatures. Of two closely cut fractions of polystyrene, the larger molecular weight sample exhibited a line transition range at a higher temperature. The styrene monomer as well as the two fractions exhibited the same low temperature line width of about 8 gauss. The line width transitions were also studied for three butadiene styrene co-polymers at temperatures where anomalous behavior was found in dynamic measurements. The theoretical implications of these experimental results, together with a survey of other pertinent work, indicate the possibilities of the nuclear resonance method as applied to the study of high polymers in conjunction with other methods. (auth)

5851

ON THE SPATIAL ALIGNMENT OF NUCLEI. B. Bleaney. Proc. Phys. Soc. (London) 64A, 315-16(1951) Mar. (Letter to the editor)

The method of Gorter (Physica 14, 504(1948)), involving the magnetic interaction between the electron shells and the nucleus, and that of Pound (Phys. Rev. 76, 1410(1949)), involving the electrostatic interaction with the nuclear quadrupole moment, for production of polarized nuclei are briefly discussed. It is pointed out that in certain cases alignment of the type envisaged by Pound can be obtained by demagnetizing a paramagnetic salt, with hyperfine structure due to magnetic interaction, to zero magnetic field. This simplifies the experimental procedure and enables lower temperatures to be reached than in Gorter's method. The method suggested depends on the fact that in a number of salts investigated by paramagnetic resonance, the hyperfine structure is found to be exceedingly anisotropic. Specific requirements and techniques are mentioned.

5852

THE MASS OF Cl^{39}. D. H. Wilkinson and J. H. Carver. Phys. Rev. 83, 466-7(1951) July 15. (Letter to the editor)

Results of proton-energy distribution measurements in the photodisintegration of A^{40} (Phys. Rev. 83, 466(1951) July 15) are used to calculate the mass of Cl^{39}. The proton group at 6.8 ± 0.1 Mev is identified with the ground-state transition, and from this a Cl^{39} mass of 38.97871 ± 10 AMU is computed.

5853

ON THE RATIO OF THE NUCLEAR MAGNETIC AND ELECTRIC QUADRUPOLE INTERACTIONS FOR ATOMIC Cl^{35} and Cl^{37}. Vincent Jaccarino and John Gordon King. Phys. Rev. 83, 471-2(1951) July 15. (Letter to the editor)

The hyperfine structure of the $^2P_{3/2}$ state of the stable Cl isotopes has been reexamined by the atomic-beam r-f magnetic-resonance method. The new measurements resolve the discrepancy that has existed between the ratio of the nuclear magnetic dipole interaction constants, a^{35}/a^{37}, and the ratio of the nuclear magnetic moments, μ^{35}/μ^{37}, as measured directly in nuclear-induction experiments. The new results for the ratio of the quadrupole interaction constants, b^{35}/b^{37}, agree with recent measurements by Livingston of the ratio of the Cl quadrupole interaction constants in solid crystals (Phys. Rev. 82, 289(1951)). The following values were obtained:

$a^{35} = 205.050 \pm 0.005$ Mc/sec, $b^{35} = 54.873 \pm 0.005$ Mc/sec,
$a^{37} = 170.681 \pm 0.010$ Mc/sec, $b^{37} = 43.255 \pm 0.010$ Mc/sec.
$Q^{35} = (-0.07894 \pm 0.00002) \times 10^{-24}$ cm^2,
$Q^{37} = (-0.06213 \pm 0.00002) \times 10^{-24}$ cm^2.

5854

A PRELIMINARY SURVEY OF THE PARAMAGNETIC RESONANCE PHENOMENA OBSERVED IN RARE EARTH ETHYL SULPHATES. R. J. Elliott and K. W. H. Stevens. Proc. Phys. Soc. (London) 64A, 205-7(1951) Feb. (Letter to the editor)

Report is made of the results of some preliminary theoretical investigations using a crystalline electric field hypothesis to account for the magnetic properties of rare-earth ethyl sulfates of form $M(C_2H_5SO_4)_3 \cdot 9H_2O$ at low temperatures. First-order perturbation theory is used. Using the values given by Bleaney and Scovil (Proc. Phys. Soc. (London) 64A, 204(1951) Feb.) for the constants in their Hamiltonian, the authors have estimated the magnitudes of the nuclear magnetic moments and have set upper limits to the nuclear electric quadrupole moments of Nd^{143}, Nd^{145}, and Er^{167}.

5855

NUCLEAR SPIN OF ERBIUM-167. B. Bleaney and H. E. D. Scovil. Proc. Phys. Soc. (London) 64A, 204-5(1951) Feb. (Letter to the editor)

The paramagnetic resonance spectrum of a single crystal of erbium ethyl sulfate, diluted with lanthanum ethyl sulfate, has been observed at 1.2 cm wavelength. For all directions of the external magnetic field a single strong line is found; centered on this is a set of eight almost equally spaced weak lines. The relative intensity of these lines, and their variation with angle, is consistent with their assignment to the hyperfine structure of the single odd isotope of mass 167. It follows that the nuclear spin of this isotope is 7/2. The spectrum has been analyzed in terms of the usual Hamiltonian. The anisotropy in the g-values is by far the largest yet discovered. The line-width showed an interesting effect, being dependent on the direction of the external magnetic field, and varying inversely as the g-value.

5856

ON THE HYPERFINE STRUCTURE OF HYDROGEN AND DEUTERIUM. F. E. Low and E. E. Salpeter. Phys. Rev. 83, 478(1951) July 15. (Letter to the editor)

Consideration is given to the ratio of the hyperfine structures, ν_D/ν_H, of D_2 and H_2. Recent low-energy measurements on the neutron-proton forces have made it possible to evaluate the expectation value for the S-state part of the wave function for the deuteron ground state, thus altering the numerical result of Low's calculation (Phys. Rev. 77, 361(1950)) of the effect of the structure of the deuteron on ν_D/ν_H. In addition, a nuclear recoil correction term changes the ratio. The effects of these two corrections are evaluated, and it is concluded that the rather large difference between theory and experiment is a result of the structure of the nucleons themselves.

5857

RADII OF EVEN-EVEN NUCLEI WITH ALPHA-FINE STRUCTURE. Melvin A. Preston. Phys. Rev. 83, 475-6(1951) July 15. (Letter to the editor)

In evaluation of nuclear radii for even-even α emitters Perlman and Ypsilantis (Phys. Rev. 79, 30(1950)) and Kaplan (Phys. Rev. 81, 962(1951)) did not take into account the effect of the angular momentum of the α particle on the value obtained for the radius. The magnitude of this small effect is now evaluated for Th^{230}, Th^{228}, and Ra^{226}.

5858

NUCLEAR MAGNETIC RESONANCE ABSORPTION IN $NaSbF_6$. E. R. Andrew. Phys. Rev. 82, 443-4(1951) May 1. (Letter to the editor)

The fine structure in the nuclear absorption line for Sb^{121} and Sb^{123} in an aqueous solution of Na hexafluoantimonate and HF (Phys. Rev. 81, 20(1951)) is discussed from the

theoretical point of view, assuming that rapid ionic reorientation takes place about one axis only.

5859

AN INVESTIGATION OF BREMMSTRAHLUNG BY MEANS OF THE NUCLEAR ISOMERISM OF INDIUM. Edwin J. Schillinger, Jr., Bernard Waldman, and Walter C. Miller. Phys. Rev. 83, 320-3(1951) July 15.

A magnetic-deflection technique has been employed in a reinvestigation of the thin-target x-ray excitation of In^{115}. The results of this investigation confirm the earlier results of Miller and Waldman. Activation levels have been found at 1.08 ± 0.02 Mev, 1.47 ± 0.02 Mev, and 1.60 ± 0.02 Mev. The latter level is reported for the first time. Above 1.65 Mev the increase in activity can be attributed to a rise in the isochromats and/or many unresolved levels of relatively small cross sections. The over-all cross section (per electron incident on a 30-mg/cm^2 gold target) is $\simeq 10^{-34}$ cm^2 at 1.4 Mev. (auth)

5860

ANGULAR CORRELATION BETWEEN THE NEUTRON AND THE GAMMA RAY IN DISINTEGRATIONS $Li^7(d,n)Be^{8*}(\gamma)Be^8$ and $Li^6(d,n)Be^{7*}(\gamma)Be^7$. Jacques Thirion. Compt. rend. 233, 37-8(1951) July 2. (In French)

Measurements of the angular correlation n-γ in disintegrations of natural Li by deuterons gave a dependence $1 - A\cos^2\theta$ with A = 0.41 ± 0.03 for 550-kev deuterons, and A = 0 ± 0.2 for 1.1 Mev deuterons. The first of these two values points to a spin 1 of the nucleus Be^{8*} (level 4.9 Mev). From other experiments, in which the isotope Li^6 alone served as a target and the correlation n-γ was found to be zero, it followed that the spin of Be^{7*} (level 434 Mev) was 1/2. This agrees with the author's previous finding (from the disintegration $Li^6(d,p)Li^{7*}(\gamma)Li^7$) that the spin of Li^{7*}, the image nucleus of Be^{7*}, is also 1/2.

5861

MULTIPOLE OSCILLATIONS OF PROTONS AGAINST NEUTRONS IN THE DROP MODEL OF ATOMIC NUCLEI. Michael Danos and Helmut Steinwedel. Z. Naturforsch. 6a, 217-18(1951) Apr. (Note; in German)

Developing the ideas of Steinwedel et al. (Z. Naturforsch. 5a, 413(1950)) and Jensen et al. (ibid., 5a, 343(1950)) on the dependence of (γ,n) resonances at high γ energies on dipole oscillations in the nucleus, the following effects are considered: (1) the influence of the Coulomb-energy perturbation on the proper frequencies of the nucleus, (2) the effect of local "sound velocities" due to the nonhomogeneous proton distribution, and (3) the role of high-multipolarity oscillations.

5862

MASSES OF KRYPTON-82, -84 and -86 AND XENON-129 AND -132. Cort L. Kegley and Henry E. Duckworth. Nature 167, 1025(1951) June 23. (Letter to the editor)

The following mass values were obtained by the mass-spectrographic doublet method using triply charged Xe ions and doubly charged Kr ions obtained from a Nier-type ion source: Kr^{82}, 81.93843 ± 0.00029; Kr^{84}, 83.93850 ± 0.00029; Kr^{86}, 85.93658 ± 0.00024; Xe^{129}, 128.945.36 ± 0.00026; and Xe^{132}, 131.94727 ± 0.00060.

5863

NUCLEAR MOMENTS AND MODELS OF NUCLEI. Hans Kopfermann. Naturwissenschaften 38, 29-34(1951) Jan. (In German)

The present-day empirical knowledge of nuclear angular momenta and of magnetic-dipole and electric-quadrupole moments of nuclei is reviewed. Attempts at establishing correlations between these magnitudes and the nature and number of nucleons are outlined, and models of nuclei which have been offered for their interpretation are discussed. 25 references.

5864

NUCLEAR MAGNETIC RESONANCE FINE STRUCTURE IN LIQUIDS. H. S. Gutowsky and D. W. McCall. Phys. Rev. 82, 748-9(1951) June 1. (Letter to the editor)

Multiple nuclear magnetic resonance lines with separations of about 0.3 and 0.7 gauss, respectively, have been observed for F^{19} and P^{31} in several liquid phosphorus halides. The ratio of the P^{31} line splitting to that for F^{19}, in the same compound, equals $\mu(F^{19})/\mu(P^{31})$, indicating that the effect is associated with the local nuclear magnetic dipole fields in the molecule. The structure and amount of splitting in $POCl_3$, $POCl_2F$, $POClF_2$, and CH_3OPF_2 are tabulated and analyzed briefly.

5865

THE SPIN OF O^{18}. S. L. Miller, A. Javan, and C. H. Townes. Phys. Rev. 82, 454-5(1951) May 1. (Letter to the editor)

Observation of the microwave absorption spectra of O^{16}-O^{18} and $O^{18}O^{18}$ in the 5-mm region shows that the spin of O^{18} is zero. This is indicated by the comparative weakness of the $O^{18}O^{18}$ lines in the K = 7, J = 6 → 7 transition, and is proved by the absence of alternating rotational levels of O^{18}-O^{18}.

5866

NUCLEAR RESONANCE IN FLOWING LIQUIDS. G. Suryan. Proc. Indian Acad. Sci. 33, 107-11(1951) Feb.

Nuclear magnetic resonance in flowing liquids has been investigated experimentally. A sample saturated by a r-f field was continuously replaced by flow of a liquid through the r-f coil in a magnetic field. Signals recorded on an oscillograph afforded a clear demonstration of relaxation time and saturation in nuclear magnetic resonance and afforded a method of measuring relaxation times directly.

5867

NUCLEAR RESONANCE IN CRYSTALS. E. M. Purcell. Physica 17, 282-302(1951) Mar.-Apr.

In crystals, the nuclear spin-lattice relaxation time, t_1, is generally very long while the spin-spin relaxation time, t_2, is very short. In very few instances, however, is t_1 as long as it ought to be in a perfect crystal. Usually the dominant relaxation process involves not the lattice vibrations but internal molecular or ionic rotations, or possibly paramagnetic impurities. The temperature dependence of t_1 gives considerable information about internal rotation. Experiments on a number of crystals, including the ammonium halides, are described, and the relation of these studies to line-shape investigations is discussed. (auth)

5868

HYPERFINE STRUCTURE BY THE METHOD OF ATOMIC BEAMS; PROPERTIES OF NUCLEI AND OF THE ELECTRON. P. Kusch. Physica 17, 339-53(1951) Mar.-Apr.

The fundamental experimental methods of molecular beams as applied to the observation of atomic hyperfine structure and its Zeeman effect are discussed, with emphasis on special techniques which have made it possible to obtain some of the recent important results derived from the observation of hfs. Among these are: (a) the determination of the nuclear spin of the radioactive isotopes Na^{22}, K^{40}, Cs^{135}, Cs^{137}; (b) the determination of the quadrupole moments of the nuclei Al^{27}, Cl^{35}, Cl^{37}, Ga^{69}, Ga^{71}, In^{113}, and In^{115} from a measurement of the interaction energy of the nuclear magnetic dipole and electric quadrupole moments with the electron configuration and a prior knowledge of the magnetic dipole moment; (c) the investigation of the anomaly between the ratio of the observed hfs splitting and the ratio of the magnetic moments of two isotopes The anomaly has been observed for H, Li, K, and Rb and its detection is possible only because of the very high precision with which the frequencies of lines in the hfs spectrum may be found by use of the method of atomic beams. Important conclusions as

to the structure of the nucleus are derived from the anomaly; (d) the precise determination of the magnitude of the anomalous spin magnetic moment of the electron, essentially by a measurement of the ratio of atomic g values for different electronic energy states. (auth)

5869
AN EXPERIMENTAL INVESTIGATION OF THE NUCLEAR MAGNETIC MOMENTS OF D^2 AND H^1. Gunnar Lindström. Physica 17, 412-19(1951) Mar.-Apr.

The magnetic moment of D^2 is measured against the magnetic moment of H^1 in two different chemical compounds (H_2O and paraffin oil) according to the resonance absorption method introduced by Purcell et al. The two samples are placed at different places in the magnetic field. The h-f bridge with the H^1 sample is fed by 28 Mc from a frequency standard and the other bridge is fed from a heterodyne-frequency-meter, which is calibrated during the measurements against a 10-kc signal from the standard. With this arrangement it is possible to measure the frequency to the bridge with the D^2 sample with an accuracy of 1 part in 5.10^6. The two signals are photographed on a double-beam oscillograph. Pictures are taken with slightly different frequencies near the correct value and the measured differences are plotted against the frequency. The correct value can then be located with very high accuracy. The samples are changed and the measurements repeated.

According to these measurements there seems to be a small effect of the chemical compounds, because the results are:

$\mu_D/\mu_H = 0.30701337 \pm 0.00000050$ (D_2O and H_2O)
and $\mu_D/\mu_H = 0.30701465 \pm 0.00000050$ (D_2O and paraffin oil).

The measured difference in magnetic moments for protons in paraffin oil and in H_2O is 1.0000041 ± 0.0000030. The maximum deviation from 30 measurements is only about 0.00000020, but as a conservative estimate the errors given here refer to the tenth of the line width, which gives 0.00000050. The measurements will be repeated with other chemical compounds. (auth)

5870
DETERMINATION OF NUCLEAR MAGNETIC MOMENTS BY SUPER-REGENERATIVE TECHNIQUES. Dudley Williams. Physica 17, 454-60(1951) Mar.-Apr.

Electronic circuits oscillating under super-regenerative conditions have been used to observe nuclear magnetic resonances for 23 nuclear species. The circuits are described, and the nuclear g-factors and magnetic moments are given. The values for the nuclear magnetic moments have been determined in terms of the proton moment and are believed to be accurate to approximately one part in twenty thousand. (auth)

NUCLEAR REACTORS

5871
Office of Naval Research, London, England
ORGANIZATION OF THE NORWEGIAN-DUTCH NUCLEAR REACTOR PROGRAM; by S. Fred Singer. Aug. 2, 1951. 2p. (NP-3321)

The heavy-water reactor being constructed at Kjeller, near Oslo, Norway, will develop between 100 and 1000 kw. The total weight of U is approximately 1 ton. Pure U billets are used, about 1¼ in. in diameter and about 8 in. long. These are held in Al tubes about 7 ft long, assembled in groups of two, each assembly weighing about 60 kg. These hang vertically in an Al tank filled with heavy water. The tank has a diameter of 2.5 m and is 3.5 m deep. A heavy water–water heat-exchanger is used; the heat in the water is dissipated by fin coolers and air blowers. Two Cd rods are used for control of the power level of the pile. One Cd rod is an emergency rod used to shut off the pile; it is simply dropped into the tank in case of emergency. Graphite and concrete shielding are used around the pile; two horizontal cylindrical tubes of about 3 in. diam lead through the shielding and will be used for exposures to the neutron flux. This unclassified reactor is operated by the Norwegian-Dutch Joint Establishment for Nuclear Energy Research (also known as Institutt for Atomenergi). Personnel are listed.

5872
Westinghouse Atomic Power Div.
STUDY OF THE VENTILATION REQUIREMENTS FOR POWER REACTOR COMPARTMENTS; NAVAL REACTOR PROGRAM. William O. Passarelli, Jr. May 14, 1951. Decl. Sept. 6, 1951. 41p. (AECD-3228; WAPD-EM-90)

The ventilation requirements for power-reactor compartments for ensuring that operating personnel will be protected from breathing more than a tolerable amount of radioactively contaminated air have been investigated. Various equations necessary for the calculation of the radioactivities, and the allowable leakage rates of reactor coolant have been derived and the variables expressed so that the data calculated are in a general form and applicable to any thermal reactor system (provided the corrosion products in the reactor coolant are the same).

5873
Oak Ridge National Lab.
ELEMENTARY THEORY OF NEUTRON SOURCES IN REACTORS. A. V. H. Masket. May 18, 1951. 26p. (AECD-3227; ORNL-1014)

The theory of neutron sources in reactors is discussed employing elementary diffusion theory, considering a bare reactor, and with restriction to one group theory. Only the steady state of the reactor—the equilibrium conditions after a sufficiently long time following any change in the reactor such as the introduction of a neutron source—is considered.

5874
BASIC CALCULATIONS IN THE DESIGN OF A NUCLEAR REACTOR. C. Salvetti. Rend. seminar mat. e fis. Milano 21, 1-23(1950). (In Italian)

Fundamentals of computations to be used in designing a nuclear reactor are complemented by a brief outline of the author's theory of an experimental method for the measurement of critical parameters of a reactor by determining the Laplacian of an element of the structure.

NUCLEAR TRANSFORMATION

5875
Radiation Lab., Univ. of Calif.
HIGH ENERGY NEUTRON YIELDS AND MULTIPLE TRAVERSALS OF A CYCLOTRON BEAM THROUGH THIN TARGETS; by William Jordan Knox. (thesis) July 13, 1951. 49p. (UCRL-1398)

The yields of neutrons from Be, C (graphite), Al, Cu, Ag, Pb, and U targets bombarded by 190-Mev deuterons or 340-Mev protons have been measured. A device, briefly described, was built to rotate four different targets successively into the 184-in. cyclotron beam without stopping the beam or altering its conditions of operation. Graphite monitors were placed on the front and back of each target to determine the fluxes of protons or deuterons traversing the targets. Values of relative total neutron yields per atom for targets bombarded with 190-Mev deuterons are in good agreement with a theoretical curve predicted by the stripping theory with the addition of a function proportional to Z^2 to account for the effect of the electric disintegration process. The absolute yield of neutrons from a deuteron beam was measured with considerably less precision than the relative yields. The absolute yield of neutrons from a

340-Mev proton beam was determined in terms of the $C^{12}(n,2n)C^{11}$ cross section for 270-Mev neutrons. Data on the phenomenon of multiple traversals of particles in a circulating beam through thin targets are presented quantitatively. The effects of multiple traversals on the total yield of particles from a target and on the energy distribution of these particles are discussed.

5876

Radiation Lab., Univ. of Calif.

NUCLEAR EXCITATION AND RECOIL BY HIGH ENERGY PARTICLES (thesis); by Si-Chang Fung. [nd] 61p. (UCRL-1465)

Excitation curves of $Bi^{209}(d,p)Bi^{210}$, $Bi^{209}(d,n)Po^{210}$, $Bi^{209}(d,3n)Po^{208}$, $Bi^{209}(d,5n)Po^{206}$, $Bi^{209}(\alpha,2pn)Bi^{210}$, $Bi^{209}(\alpha,p4n)Po^{208}$, and $Bi^{209}(\alpha,p6n)Po^{206}$ have been determined in an effort to see how much energy a nucleon can possess and still remain in the nucleus. The cross section of the $Al^{27}(\alpha,\alpha 2pn)Na^{24}$ reaction with 340-Mev α particles also has been determined. The experimental data indicate that the (d,p) and (d,n) reactions on Bi are due mainly to the capture of a neutron or a proton in a zero or negative energy state or with a positive energy up to several Mev during stripping. The experimentally observed cross sections decrease with energy above 100 Mev much more rapidly than Peaslee's expression (Phys. Rev. 74, 1001(1948)) indicates. It seems probable that the sticking probabilities ξ_p and ξ_n are decreasing functions of energy in the high-energy region. The energy dependence of the forward recoil loss of Na^{24} produced in Al foil by bombardment with high-energy protons, deuterons, and He ions has been investigated. In low-energy regions, the recoil loss increases as the energy of the incident particle increases, which is consistent with compound nucleus formation as postulated by Bohr. The percentage of recoil then passes through a maximum and decreases as the energy of the incident particle increases.

5877

Los Alamos Scientific Lab.

ENERGY DEPENDENCE OF (n,2n) REACTIONS IN Ni^{58}, Cu^{63}, AND Tl^{203} FROM 11 TO 19 MEV; by H. C. Martin and B. C. Diven. [nd] Decl. Sept. 10, 1951. 6p. (AECD-3233; LADC-1019)

The energy dependence of the $Ni^{58}(n,2n)Ni^{57}$, $Cu^{63}(n,2n)Cu^{62}$, and $Tl^{203}(n,2n)Tl^{202}$ reactions has been investigated, using neutrons from the $D(T,n)He^4$ reaction. The calculated energies of the neutrons varied from 18.5 Mev at a laboratory angle of 0° to 11.3 Mev at 180°, and the total flux was roughly 1.4×10^7 neutrons/μcoulomb. It was assumed that the laboratory flux was symmetric at 1.80 Mev. The 36-hr Ni^{57} decay and the 9.8-min Cu^{62} decay were followed by means of a thin-wall G-M counter. A single-channel analyzer was used with a NaI(Tl) scintillation detector to count pulses in the photopeak from the 431 ± 10 kev Tl alpha. The decay of the Tl gamma was followed for three half lives and best fitted a 300 ± 15 hr half life. Graphs of the energy dependence of the three reactions are included.

5878

Brookhaven National Lab.

MEASUREMENT OF SOME INTERNAL CONVERSION COEFFICIENTS. A. W. Sunyar. [nd] 5p. (AECU-1590)

The internal conversion coefficients for the isomeric transition of Cd^{111m}, Cs^{134m}, and Ta^{182m} were calculated from x ray/γ ray ratios found with a scintillation counter using a 1-cm^3 crystal of NaI(Tl). A single-channel differential discriminator was used for determining the pulse-height distribution. The coefficients tabulated are compatible only with the conclusion that all of the foregoing isomeric transitions are electric 2^3 pole in spite of their comparatively long lifetime.

5879

Atomic Energy Project (Canada)

NEUTRON CAPTURE γ-RAYS FROM FLUORINE, SODIUM, MAGNESIUM, ALUMINUM, AND SILICON. B. B. Kinsey, G. A. Bartholomew, and W. H. Walker. [nd] 57p. (NP-3172)

The energies and the absolute intensities of the γ rays produced by neutron capture in F, Na, Mg, Al, and Si have been measured with the aid of a pair spectrometer. Direct transitions to the ground states of the product nuclei are predominant in the γ-ray spectra of F and Al. The neutron binding energy in F^{20} is 6.60 ± 0.03 Mev and in Al^{28}, 7.724 ± 0.010 Mev. The γ ray representing the direct transition to the ground state of Na^{24} was not detected. The interpretation of the Mg spectrum presents some difficulties. A weak γ ray with the binding energy of a neutron in Mg^{25} was detected, but none could be found to correspond to the direct transition to the ground state in Mg^{26}. In Si, most captures are due to Si^{28} which produces Si^{29} with the emission of two γ rays in cascade. Very weak γ rays representing direct transitions to the ground states in Si^{29} and Si^{30} were detected. Their energies are 8.51 ± 0.04 (Si^{29}) and 10.55 ± 0.05 Mev (Si^{30}). 48 references. (auth)

5880

EXCITATION FUNCTIONS FOR PROTON REACTIONS WITH SODIUM AND MAGNESIUM. J. W. Meadows and R. B. Holt. Phys. Rev. 83, 47-9(1951) July 1.

Proton bombardment at energies up to 120 Mev have been carried out on the Harvard University cyclotron using targets of $Na^{23}NO_3$, $Mg^{25}O$, $Mg^{26}O$, and ordinary MgO. A stacked sample and absorber technique was employed, using the formation of C^{11} from interleaved polyethylene foils as a monitor. The internal scattered beam at about 180° from the scatterer and 1 inch below the median plane was employed to give better energy resolution. Absolute excitation curves have been obtained for the reactions yielding F^{18} and Na^{24} from Mg^{25} and Mg^{26}, F^{18} from Mg^{24}, and F^{18} and Na^{22} from Na^{23}. (auth)

5881

ON THE INTERPRETATION OF RESONANCE LEVELS AND THEIR WIDTHS IN TERMS OF THE SCATTERING LENGTH AND THE EFFECTIVE RANGE. T. Teichmann. Phys. Rev. 83, 141-5(1951) July 1.

The so-called effective range formula for nuclear scattering is deduced from the nuclear dispersion formalism for a fairly general class of potentials. It is shown that only in the case of zero angular momentum scattering is the angular momentum uniquely determined from the low-energy variation of the cross section. The relation between the scattering length and effective range on the one hand and the parameters of nuclear dispersion theory (resonance levels and reduced widths) is briefly discussed. (auth)

5882

POLARIZATION EFFECTS IN (n−γ) REACTIONS. Otto Halpern. Phys. Rev. 82, 753(1951) June 1. (Letter to the editor)

The use of polarized neutron beams permits reactions to be induced in which the reaction products may show certain characteristic polarization properties. An example is cited in which a polarized neutron is captured by a nucleus of spin 0, with the resultant nucleus being partially polarized, the γ rays radiated perpendicular to the direction of the neutron spin being unpolarized, and the γ rays emitted along the direction of neutron spin being circularly polarized.

5883

THE REACTIONS $^{11}B(\gamma,\alpha)^7Li$ AND $^{11}B(\gamma,T)^8Be$. Margaret E. Calcraft and E. W. Titterton. Phil. Mag. 42, 666-9(1951) June (Correspondence).

To obtain information about possible modes of disintegration of B^{11}, B-loaded E_1 emulsions have been exposed to Li γ rays from 440-kev (p,γ) resonance. There is definite evidence for the occurrence of the reaction $B^{11} + h\nu \rightarrow He^4 + Li^7 - 8.6$ Mev. Among the 750 3-particle stars observed, 50 have been identified as resulting from the reaction $B^{11} + h\nu \rightarrow H^3 + 2He^4 - 11.1$ Mev. No peak was found to indicate the presence of the process $B^{11}(\gamma,\alpha)Li^{7*}$; $Li^{7*} \rightarrow H^3 + He^4$, and at least 85% of the events apparently proceed through the mechanism $B^{11}(\gamma,T)Be^{8*}$; $Be^{8*} \rightarrow 2He^4$.

5884

CROSS-SECTION FOR THE REACTION $^9Be(p,p2n)^7Be$ AT 156 MEV. T. C. Randle, J. M. Dickson, and J. M. Cassels. Phil. Mag. 42, 665(1951) June. (Correspondence)

A "sandwich" target containing two thick sheets of Be and three thin sheets of C was bombarded with 171-Mev protons. The γ-ray activities induced in both the target elements have since been followed for 104 days, using a Geiger counter and a standard geometrical arrangement. The cross section for the formation of Be^7 from C is $11.0 \pm 1.0 \times 10^{-27}$ cm^2 at the effective proton energy of 156 Mev. The activity of the Be part of the target was analyzed and found to be due chiefly to Be^7. The $Be^9(p,p2n)Be^7$ cross section is $9.2 \pm 0.9 \times 10^{-27}$ cm^2.

5885

SCINTILLATION SPECTROSCOPY OF THE GAMMA-RAYS FROM SLOW NEUTRON CAPTURE IN MANGANESE. R. W. Pringle and G. Isford. Phys. Rev. 83, 467-8(1951) July 15. (Letter to the editor)

A scintillation γ-ray spectrometer was used to investigate the γ rays produced on irradiation of Mn by neutrons from a 50-mc Ra-Be source. The neutrons were thermalized by a paraffin wax slow-neutron howitzer. The method is described in detail, and two oscillograms are shown. γ rays from neutron capture in Mn^{55} were observed with energies of 5.32 ± 0.05 and 7.16 ± 0.05 Mev.

5886

FALL AND RE-INCREASE OF THE $^{12}C(\gamma,3\,^4He)$ CROSS SECTION. J. J. Wilkins and F. K. Goward. Proc. Phys. Soc. (London) 64A, 201-2(1951) Feb. (Letter to the editor)

The investigation of the photodisintegration $C^{12}(\gamma,3He^4)$ using nuclear emulsions irradiated by γ rays from the AERE synchrotron (Goward et al., Proc. Phys. Soc. (London) 63A, 402(1950)) has been continued with peak γ-ray energies up to 25.5 Mev, and about 600 stars have been analyzed. The cross-section curve shows a considerable and effectively vertical drop at $E_T(\simeq 12$ Mev, or $E_\gamma) \simeq 19.3$ Mev where E_t = total energy release of stars caused by carbon disintegrations and E_γ = γ-ray energy. The subsequent reincrease in cross section is now firmly established by the observation of some 80 stars with $E_T > 14$ Mev. A reasonable estimate of the maximum cross section is 2.4×10^{-28} cm^2, but this may still easily be an underestimate by about 50%. Possible explanations of the cross-section curve shape are considered.

5887

NEUTRON THRESHOLDS IN LIGHT ELEMENTS. E. B. Tucker. Phys. Rev. 83, 473-4(1951) July 15. (Letter to the editor)

An investigation of the neutron thresholds obtained by 0 to 3.5-Mev deuteron bombardment of Li, Be, B (natural and enriched), C, and PbF_2 targets has been carried out. The cyclotron beam passed through a range cell filled with He for varying the bombarding energy before hitting the target, and the neutrons were detected by a BF_3 counter. Experimental curves of relative number of counts vs. deuteron energy are shown and interpreted. The detection system was such that both resonances and thresholds could be observed.

5888

FAST NEUTRON ENERGIES DETERMINED BY THE USE OF RESONANT SCATTERERS. P. H. Stelson and W. M. Preston. Phys. Rev. 83, 469-70(1951) July 15. (Letter to the editor)

A method is described for determining fast-neutron energies by measuring scattering cross sections, using as scatterer an element whose cross section is a known function of neutron energy, and as source neutrons of unknown energy produced by monoenergetic protons incident on thin targets of the nuclei of interest. The identification of resonances then permits deduction of the energy of the neutrons and hence the Q-value of the reaction. With Be as the scatterer the method yielded a Q-value of -1.006 ± 0.010, and hence a threshold of 1.024 ± 0.010 Mev for the $Mn^{55}(p,n)Fe^{55}$ reaction. With a Li scatterer a Q-value of -1.771 ± 0.010 Mev was found for the $Cr^{53}(p,n)Mn^{53}$ reaction. An upper limit of ~2 kev was determined for the width of the ground state of Be^9 by measuring the sharp resonance at 585 kev in the total neutron cross section of sulfur, using neutrons produced by the $Be^9(p,n)B^9$ reaction.

5889

NUCLEAR ELECTRON PAIRS FROM $F^{19}(p,\alpha)^*O^{16}$. G. C. Phillips and N. P. Heydenburg. Phys. Rev. 83, 184-5(1951) July 1. (Letter to the editor)

The reaction $F^{19}(p,\alpha)O^{16*}$ yielding pairs of electrons from the excited state at 6.05 Mev in O^{16} has been studied. Detection of the electrons was accomplished by means of two anthracene scintillation counters in coincidence. The observed pair resonances occur at the following bombarding proton energies (widths in parentheses): 710 (35), 842 (24), 1130 (43), 1236 (58), and 1367 (26) kev. The angular correlation of the pairs was determined in the plane normal to the proton-beam direction for a bombarding energy of 1.23 Mev. If a γ-ray-counting efficiency of about 2% for the possible continuous spectrum of γ rays is assumed, it appears that γ-ray pairs number not more than 50% of the electron pairs.

5890

NOTE ON TOTAL YIELD OF ALPHAS FROM $Li^6(d,\alpha)\alpha$. Robert Resnick. Phys. Rev. 82, 447(1951) May 1. (Letter to the editor)

The fit of the theoretical curves (Phys. Rev. 76, 1318 (1949)) of angular distribution of alpha particles in $Li^6(d,\alpha)\alpha$ with experiment (Phys. Rev. 74, 405(1948)) and the reasonable values of the parameters required for such a fit suggest that the assumptions of one sharp state and one broad state are valid in the energy range investigated (0 to 4 Mev).

5891

RESONANCE PHENOMENA IN (γ, n), (γ, p), and (γ, 2n) REACTIONS MEASURED BY THE TECHNIQUE OF SIMULTANEOUS ACTIVATION. R. Sagane. Phys. Rev. 83, 174-5(1951) July 1. (Letter to the editor)

A study of resonance phenomena, not only in (γ, n) but also in (γ, p), (γ, 2n), and perhaps in (γ, pn) and (γ, γ) reactions, has been made by comparing the saturation intensity of activities produced by simultaneous bombardment of several different elements with x rays. Tests were made on samples of thin plates of C (polystyrene), Mg, Cu, Mo, and Pb, bombarding most of them simultaneously for suitable periods of time with x rays of 10 to 61 Mev E_{max}. The decay of the radioactivity produced in each of the samples was measured, and saturation intensities were calculated from these data for each of the periods.

5892

PHOTOPROTONS FROM ARGON UNDER THE ACTION OF GAMMA-RAYS OF 17.6 MEV. D. H. Wilkinson and J. H. Carver. Phys. Rev. 83, 466(1951) July 15. (Letter to the editor)

The energy distribution of the photoprotons ejected from A^{40} by γ rays of 17.6 Mev produced in the reaction $Li^7(p, \gamma)Be^8$ has been determined by means of a proportional counter and a 99-channel kicksorter. A graph shows that the highest peak occurs at roughly 3 Mev; a plateau appears near 4 Mev; and two peaks are noted at roughly 6 and 7 Mev, respectively. It is concluded that the bulk of the disintegration cannot be the result of a surface photoelectric effect, as this would give the main group at high energy. The (γ, p) cross section is 5.4 mb. The (γ, n) to (γ, p) cross-section ratio computed from coulomb wave functions does not agree with the experimental ratios.

5893

THE REACTION $^{23}Na(d, \alpha)^{21}Ne$. A. P. French and D. M. Thomson. Proc. Phys. Soc. (London) 64A, 203-4(1951) Feb. (Letter to the editor)

The energy distribution of α particles from the reaction $Na^{23}(d, \alpha)Ne^{21}$ was studied with the aid of a differential ionization chamber and an air absorption cell. The Q values for the four groups observed are 6.84 ± 0.05, 6.46 ± 0.04, 5.09 ± 0.04, and 4.08 ± 0.06 Mev, and the corresponding excitation energies in Ne^{20} are 0, 0.38 ± 0.02, 1.75 ± 0.04, and 2.76 ± 0.05 Mev. These values agree satisfactorily with those of Hornyak et al. (Revs. Modern Phys. 22, 291 (1950)), which were calculated on the basis of $Ne^{20}(d, p)Ne^{21}$ experiments.

5894

THE REACTION $^6Li(\gamma, n)^5Li$ AND ENERGY LEVELS OF THE ^5Li NUCLEUS. E. W. Titterton and T. A. Brinkley. Proc. Phys. Soc. (London) 64A, 212-14(1951) Feb. (Letter to the editor)

Ilford E1 emulsions loaded with the separated isotope Li^6 have been irradiated with γ rays from the 440-kev Li^7 pγ resonance and have yielded definite evidence for the reaction $Li^6 + h\nu \rightarrow n^1 + Li^5 - Q^1$; $Li^5 \rightarrow H^1 + He^4 + Q_2$. The recoiling Li^5 nucleus (having a lifetime of about 10^{-21} sec) breaks up into a proton and an alpha particle to form a V-track in the emulsion. Seventy events have been observed, and in about 50% of the cases it is clear by inspection which track of the V is the proton. Definite groups were found corresponding to breakup of Li^5 from the ground state. A value for the instability of the state is found to be $Q_2 = 1.6 \pm 0.2$ Mev, and from this Q_1 can be derived and is 5.4 ± 0.2 Mev. While the evidence is not so strong as in the case of the ground state, a broad level is suggested in the Li^5 nucleus at 2.5 ± 0.5 Mev. A preliminary value for the mean cross section of the reaction $Li^6(\gamma, n)$ for the Li^7 pγ radiations is found to be $(5 \pm 2) \times 10^{-28}$ cm^2.

5895

THE ANGULAR DISTRIBUTION OF PROTONS EMITTED IN SOME $F(\alpha, p)Ne$ RESONANCE REACTIONS. J. D. Jolley and F. C. Champion. Proc. Phys. Soc. (London) 64A, 88-9 (1951) Jan. (Letter to the editor)

The angular distributions of the protons emitted in some $F^{19}(\alpha, p)Ne^{22}$ resonance reactions have been studied by using a disintegration camera and the photographic emulsion technique to record the emitted particles. The energies of the peaks in the intensity vs. energy distributions are, for 4.1-Mev α's, 5.06 ± 0.11 and 3.67 ± 0.13 Mev with indications of another peak at about 4.6 Mev; for the 3.7-Mev α level the peaks are at 4.64 ± 0.10 Mev and 3.22 ± 0.11 Mev with indications of another peak at 4.2 Mev. The angular distribution of the protons relative to the direction of the α beam has, for both ground-state transitions, a minimum at 90° and a maximum at 0°. The second-excited-state transitions both show minima at 0° and 90°; there is a maximum at 30° in the case of the 4.1-Mev resonance and a maximum at 45° for the 3.7-Mev resonance. Neither of the first-excited-state transitions is sufficiently intense to allow a determination of the angular distributions. The relative yields for transitions to the ground, first- and second-excited states are in the ratios 1:0.35:4 and 1:0.16:3.1 for the 4.1 and 3.7-Mev resonances, respectively.

5896

EVIDENCE OF NUCLEAR TRANSMUTATION IN THE COURSE OF EXPLOSION OF SHAPED CHARGES WITH LINED CAVITY. Zygmunt Fonberg. J. Chem. Phys. 19, 383(1951) Mar.

The appearance of electromagnetic radiation, generally at the range of x rays, during chemical reactions, when the chemical compound entering the reaction contains H, has been observed by several research workers. During the detonation of shaped charges composed of certain nitro compounds, with lined cavity, the radiation phenomenon seems to be intensified to the extent that evidence of nuclear transmutation has been observed.

5897

ANGULAR DISTRIBUTION OF PROTONS FROM $Li^6(d,p)Li^{7*}$, Li^7. D. N. F. Dunbar and F. Hirst. Phys. Rev. 83, 164-5 (1951) July 1. (Letter to the editor)

The angular distributions of the total emission and the long- and short-range proton groups from the reaction $Li^6(d,p)Li^{7*}, Li^7$ have been studied at deuteron energies <1 Mev by means of Ilford C2 photographic plates in a special camera developed previously by the authors. The intensity at an angle θ is equal to the sum of a series of Legendre polynomials with coefficients in a form which requires numerical integration. The ratios of the coefficients are compared with those obtained by other authors. The observed distributions indicate that the angular momentum of the excited level in Li^7 is ½. The angular distribution of the α particles from the reaction $Li^6(d,\alpha)He^4$ for deuteron energies between 0.2 and 1 Mev is considered briefly.

5898

THEORY OF ELECTROMAGNETIC BREMSSTRAHLUNG. Gerard Pétiau. Compt. rend. 232, 153-5(1951) Jan. 8. (In French)

Calculations of the differential cross section for bremsstrahlung emission in the collision of two charged particles are generalized by taking account of recoil and radiation of both particles. The two particles are assumed to remain distinguishable throughout the collision process; the present results are not applicable in the case of identical particles for which supplementary exchange terms must be considered.

5899

DETECTION OF $^{14}N(\gamma,d3\alpha)$ AND $^{14}N(\gamma,pn3\alpha)$ REACTIONS IN NUCLEAR EMULSIONS. F. K. Goward and J. J. Wilkins. Proc. Phys. Soc. (London) 64A, 312-13(1951) Mar. (Letter to the editor)

Stars from the reaction $N^{14} + h\nu \rightarrow 3He^4 + H^2 - 17.6$ Mev have been identified with certainty in emulsions exposed to 25.5-Mev bremsstrahlung. By studying the apparent momentum balance and considering the incident quantum energy, the authors conclude that the majority of stars observed are due to this reaction rather than $N^{14} + h\nu \rightarrow 3He^4 + H + n - 19.8$ Mev. The cross section is of the order of a few times 10^{-28} cm^2 at 23 Mev. Several apparent 3-particle stars observed, with one light track, are almost certainly nitrogen 4-particle stars with one undetectably short track. Allowing for these events, the cross section would be of the order of 10^{-28} cm^2 at 23 Mev.

5900

MAGNETIC ANALYSIS OF THE $B(\alpha,p)C$ REACTION. G. M. Frye and M. L. Wiedenbeck. Phys. Rev. 82, 960-1(1951) June 15. (Letter to the editor)

A semicircular focusing magnetic spectrograph has been used to analyze the protons in the reaction $B(\alpha,p)C$ produced

by a Po α-particle source. Four proton groups were found: (1) a low-intensity group with Q value ~3.8 Mev, (2) a group with Q value 0.75 ± 0.01, which was assigned to B^{11}, (3) a group at 0.24 ± 0.02 Mev, and (4) a group at −0.22 Mev, which was observed only for the run where the protons were observed at 90° to the α beam.

5901
PHOTONUCLEAR EFFECTS IN CARBON FROM 100-MEV BETATRON X-RAYS. E. R. Gaerttner and M. L. Yeater. Phys. Rev. 82, 461(1951) May 1. (Letter to the editor)

A methane-filled cloud chamber has been used to observe the photodisintegration of carbon nuclei by x rays from a 100-Mev betatron. The observed disintegrations form "stars," consisting of three or more tracks with a common origin, and "flags," consisting of a short heavy track from the residual nucleus and a longer, lighter track from a single emitted charged particle. The ratio of stars to flags, the cross section for the flags, and the angular distribution of flags are discussed.

5902
EXCITATION FUNCTION OF $Ta^{181}(d,p)Ta^{182}$. K.-H. Sun, F. A. Pecjak, R. A. Charpie, and J. F. Nechaj. Phys. Rev. 82, 459(1951) May 1. (Letter to the editor)

The excitation function of $Ta^{181}(d,p)Ta^{182}$ was measured by the stack foil technique, using the known excitation function of $Al^{27}(d,p\alpha)Na^{24}$ for comparison. It was found that the cross section for 15.0-Mev deuterons was 0.5 barn. Cross sections and thick target yield at other deuteron energies are graphed.

5903
THE RESONANCE PHOTO-FISSION CROSS SECTION FOR U^{238}. W. E. Ogle and J. McElhinney. Phys. Rev. 81, 344-6 (1951) Feb. 1.

An attempt has been made to determine the shape of the U^{238} photofission cross section up to a γ-ray energy of 22 Mev by an analysis of the excitation function obtained by varying the peak energy of the bremsstrahlung from a 22-Mev betatron. A resonance for the photofission process is indicated in the region of 15 Mev. (auth)

5904
ANGULAR DISTRIBUTIONS OF THE TWO GAMMA-RAYS FROM $Li^7(p,\gamma)Be^8$ REACTION. M. B. Stearns and B. D. McDaniel. Phys. Rev. 82, 450-1(1951) May 1. (Letter to the editor)

The separate angular distributions of the 14- and 17-Mev γ rays from the $Li^7(p,\gamma)Be^8$ reaction have been studied at two proton-bombarding energies. For each proton energy, observations were made of the intensities of the two γ-ray components at three angles of emission. Within the limits of error, the resonant radiation is isotropic for both components. The nonresonant radiation is strongly anisotropic, and the angular distribution is different for the two γ-ray components.

5905
ALPHA-PARTICLES FROM THE PROTON BOMBARDMENT OF PHOSPHORUS. Joan M. Freeman and J. Seed. Proc. Phys. Soc. (London) 64A, 313-14(1951) Mar. (Letter to the editor)

Short-range alpha particles from the reaction $P^{31}(p,\alpha)Si^{28}$ have been detected with the aid of a 60° magnetic analyzer. The particles were observed at an angle of 120° with the direction of the incident protons, and were detected by a thin zinc sulfide screen and an E.M.I. photomultiplier. The intensity of the α-particle group from the phosphorus reaction was studied as a function of the bombarding voltage for proton energies from 650 to 1,070 kev. The excitation function indicates resonances at 680, 900 and 1,025 kev. For comparison the positions of the resonances observed for the F^{19} and Na^{23} (p, α) reactions are also shown on the graph. The energy release in the P^{31} (p, α) Si^{28} reaction was calculated from the energy of the α-particle group measured at each of the 3 resonances. The weighted mean is Q = 1.85 ± 0.02 Mev.

PARTICLE ACCELERATORS

5906
Atomic Energy Research Establishment, Harwell, Berks (England)
FOCUSING SYSTEM FOR THE ELECTROSTATIC GENERATOR. H. S. Cockroft. June 4, 1951. 20p. (AERE-N/R-716)

The focusing effects and energy resolution obtainable from a 90° deflecting magnet on a positive ion beam are considered and it is shown that for best resolution and beam shape the slit should be a distance about 1.2 ρ from the output face of the magnet. The angles of the magnet faces and the width of the slit must be adjusted to suit the beam entering the magnet and the best resolution obtainable is then given by $(\delta\rho/\rho)_{min} = 0.6\ a/\mu$ where a/μ is the minimum angle subtended by a beam diameter at the input face of the magnet and ρ is the radius of curvature of the beam in the magnet. The accelerator tube is considered and the constants of an equivalent lens are determined. These results are used to find what conditions the beam at the top of the tube must satisfy in order to use all the beam and get best resolution. The lens system at the top of the tube is considered and the best position for the ion source determined. (auth)

5907
Los Alamos Scientific Lab.
METHOD OF OBTAINING TRITIUM ION BEAMS WITH LOW GAS CONSUMPTION. Wayne R. Arnold. [nd] 5p. (AECU-1607; LADC-1037)

Data obtained with an ion source using r-f magnetic excitation and plasma focusing in conjunction with a Cockcroft-Walton accelerator are plotted for compositions of H_2 and He from ~1 to 40% H_2. The amounts of analyzed H^+ and He^+ beams obtained for the different mixtures are shown, and the efficiency of the ion source for H_2, expressed as μamp of H^+ beam/cm^3 of H_2 consumed/hr is also plotted. The maximum efficiency appears to be somewhere below 2% H_2. At 12.5% H_2, the H^+ yield is as large as with 100% H_2. As the T_2 ionization potential is the same as that of H_2, a mixture of 1 cc T_2 with 49 cc He would give a T^+ beam of one μamp for 50 hr. It has been found that running the ion source on air for short periods inactivates impurities which catalyze the recombination of atomic H and will increase the fraction of the beam which is monatomic up to 97%.

5908
THE IMPORTANCE OF GAS SCATTERING IN PARTICLE ACCELERATORS. L. Riddiford. Proc. Phys. Soc. (London) 64A, 10-12(1951) Jan.

In electron and proton synchrotrons there exists a minimum useful vertical aperture of the vacuum chamber, and for apertures less than this the beam intensity falls to zero. It is considered, on the basis of a comparison of theory and experiment, that this phenomenon is in the main due to free oscillations which arise from gas scattering. The final beam size in proton synchrotrons may be substantial for this reason also, but for cyclotrons the large spread which is known to exist must be attributed to some other phenomenon. (auth)

5909
A ROTATING LITHIUM TARGET. Eugene Lampi. Rev. Sci. Instruments 22, 429(1951) June. (Laboratory and shop notes)

A diagram and description are presented of a rotating thin Li target for use with the Minnesota Van de Graaff

generator. The Li was evaporated on a 10-mil Ta cap by means of a furnace consisting of an iron cup heated with four turns of W wire, which was also sealed within the rotating vacuum assembly. The target has been used for hundreds of hours with very satisfactory results.

5910

THE ACCELERATION OF PARTICLE TO HIGH ENERGIES. H. R. Lang, ed. London, Institute of Physics, 1950. 58p.

This book is based on certain papers presented by the Electronics Group at the Institute of Physics at a convention in May 1949. There are four papers, and each is given a separate chapter in the book. The first deals with the cyclotron and synchrocyclotron. The principle of the betatron and the betatron-started electron synchroton is treated in Chapter II. The third chapter discusses the problems associated with the pressurized electrostatic generator. The fourth chapter is a brief one which deals mainly with the wave-guide linear accelerator. The final chapter is devoted to the discussion of the papers which took place in the morning following the conference. 9 plates, 15 diagrams.

5911

THE SYNCHROCYCLOTRON AT AMSTERDAM. F. A. Heyn. Philips Tech. Rev. 12, 241-56(1951) Mar.

The Philips synchrocyclotron at Amsterdam is producing in continuous operation deuterons with an energy of 28 Mev. A current of 20 μa is already being reached with the energy mentioned. In the general description (Part I) the most important parts of the installation are mentioned and an idea is given of the extent of the accessory apparatus required. Part II consists of a detailed description of the oscillator and the modulator. Schematic diagrams and photographs are included.

5912

PULSER FOR CYCLOTRON OSCILLATOR. W. H. Henry and J. D. Keys. Can. J. Phys. 29, 137-41(1951) Mar.

A pulser for controlling the r-f oscillator of the McGill synchrocyclotron is described. This pulser is triggered at a selected precise frequency and controls the oscillator for selected pulses or for predetermined exact periods of continuous operation. Circuit details are shown.

5913

A NOTE ON RESONANCE DAMPING, AT INJECTION, IN BETATRONS AND SYNCHROTRONS. S. E. Barden. Proc. Phys. Soc. (London) 64B, 85-6(1951) Jan. (Letter to the editor)

A theory is proposed to explain how an electron can be injected into betatrons and synchrotrons without colliding with the injector structure on subsequent revolutions. It is suggested that the mechanism of resonance damping of the free radial oscillations, brought into operation through the creation of favorable inhomogeneities by the large currents circulating at injection, plays an important part in the successful internal and external injection of electrons. Such damping is not reversible.

5914

THE YALE LINEAR ELECTRON ACCELERATOR. H. L. Schultz and W. G. Wadey. Rev. Sci. Instruments 22, 383-8(1951) June.

The Yale linear accelerator has been designed to produce large currents of 10-Mev electrons by the use of independent resonant cavities driven by 500-kw triode power amplifiers. The design principles and construction methods used for this recently completed machine and data on its performance are briefly presented. (auth)

5915

OPERATION OF A SIX-MEV LINEAR ELECTRON ACCELERATOR. G. E. Becker and D. A. Caswell. Rev. Sci. Instruments 22, 402-5(1951) June.

The operation of a 6-Mev linear electron accelerator is described. It is of the traveling-wave type, 14 feet in length. A single magnetron is used as a power source, operating at a a wavelength of 10.5 cm, with a peak power output of 0.9 Mw. Electrons are injected at a velocity v = c/2. Approximately 1/20 of the injected electrons reach the target end of the accelerator, with energies falling in a 1-Mev range near 6 Mev. The average current obtained is 0.05 μa. With an electron pulse length of 0.8 μsec and a pulse repetition rate of 60 per sec, this corresponds to a peak current of the order of 1 ma. (auth)

RADIATION ABSORPTION AND SCATTERING

5916

Brookhaven National Lab.

ANALYSIS OF 14-MEV n-p SCATTERING. (abstract) George Snow. [nd] 1p. (AECU-1602)

The report is reproduced here in its entirety.

The total S-wave n-p scattering cross section can be

$$\sigma^{(s)} = \sigma_{\text{triplet}} + \sigma_{\text{singlet}}$$

$$= \frac{3\pi}{[k^2 + (\alpha_t - \tfrac{1}{2}\rho_t k^2)^2]} + \frac{\pi}{[k^2 + (\alpha_s - \tfrac{1}{2}\rho_s k^2)^2]^2}$$

α_t, r_{ot}, and α_s are determined from the deuteron binding energy and the thermal and epithermal n-p scattering cross sections. Hence $\sigma^{(s)}_{\text{total}}$ is a function of the unknown effective singlet range, r_{os}, for an assumed well shape, if the neutron energy is known. The neutron-energy distribution from the D-T reaction has been calculated, including the effects of deuteron scattering and energy loss in the target; 95% of the neutrons have relativistic kinetic energies between 13.88 and 14.23 Mev, and $[(\overline{1/E_n})]^{-1}$ = 14.08 ± 0.05 Mev. From the experimental n-p cross section and the equation, r_{os} has been obtained for three choices of potential well shape, square (S), exponential (E) and Yukawa (Y). Exact S-wave phase shifts have also been calculated and the resultant small corrections to $\sigma^{(s)}$ of the equation have been made. The results are r_{os} = 2.23 ± 0.25 (S), r_{os} = 2.28 ± 0.33 (E), r_{os} = 2.29 ± 0.40 (Y).

5917

RAND Corp.

GAMMA-RAY TRANSMISSION THROUGH FINITE SLABS; PART I; by G. H. Peebles. July 23, 1951. Decl. Sept. 25, 1951. 50p. (AECD-3239; RM-653)

The probability that a photon will be transmitted through a slab of finite thickness but infinite extent is the sum of the probabilities that it will be transmitted with no scatterings, one scattering, two scatterings, etc. Thick slabs require the calculation of the transmission for an excessive number of scatterings, but, if errors of the order of 20 to 30% are acceptable, estimates of the total transmission are possible from relatively few scatterings, particularly in the case of the heavy materials where the absorption from the photoelectric effect and pair production is large. The first few scatterings have been calculated and estimates have been made of the total transmission for monoenergetic, monodirectional photons falling on slabs of Pb and Fe. Calculations are tabulated for slab thickness from 0 to 20 mean free paths, incident energy from 1 to 20 mc^2, and incident angle from 0 to 90°. Bremsshtralung and polarization were neglected. Backscatter was not neglected at the outset, but it was found that it could be ignored, at least within the scope of these calculations.

5918

Radiation Lab., Univ. of Calif.

EXPERIMENTS ON SCATTERING OF 190-MEV DEUTERONS

BY PROTONS. (thesis) Arnold L. Bloom. Aug. 15, 1951. 57p. (UCRL-1442)

The total cross section for scattering of 190-Mev deuterons on protons and the differential cross section for certain types of inelastic deuteron-proton scattering were measured in the external deuteron beam of the Berkeley synchrocyclotron. The total cross section was determined by measuring the differential cross section for scattering of charged particles from a hydrogen target. The cross section obtained is $92 \pm 7 \times 10^{-27}$ cm^2, with Rutherford scattering excluded. Cross sections for inelastic scattering in which both protons suffer large changes of momentum have been examined by measuring coincidences between scattered protons; it is found that the protons are scattered nearly 90° apart in the laboratory system, with a narrow distribution in angle owing to the internal momentum of the deuteron. The differential cross sections for this process are summarized. Comparison of the experimental results is made with theory. 17 references. (auth)

5919

Radiation Lab., Univ. of Calif.

EXPERIMENTS ON ELASTIC SCATTERING OF 190-MEV DEUTERONS BY PROTONS. Martin O. Stern. Aug. 1951. 55p. (UCRL-1440)

The elastic differential scattering cross section of 190-Mev deuterons by protons has been measured from 15 to 170° in the center of mass system. The cross sections were obtained by subtracting the carbon counts from those received with a polyethylene target. A scintillation coincidence counting technique was used over most of the range of angles measured. Results are shown in tabular and graphical form and compared with those predicted by Chew (Phys. Rev. 74, 809(1948)). 40 references. (auth)

5920

Columbia Univ.

THE ENERGY DEPENDENCE OF THE RESONANT SCATTERING OF SLOW NEUTRONS FROM GOLD. (dissertation) Jay Tittman and Charles Sheer. Apr. 25, 1951. 42p. (CUD-64(rev.); DR-1570)

The energy dependence of slow neutrons scattered from a thick Au target has been measured using a newly developed scattering chamber in conjunction with the Columbia slow-neutron velocity spectrometer. A method of analysis has been developed for determining the ratio of the scattering cross section to the total cross section, σ_s/σ_t, as a function of energy for an "unknown" sample in terms of a calibration target for which $(\sigma_s/\sigma_t)(E)$ is known. The agreement between the experimental determination of $(\sigma_s/\sigma_t)(E)$ for Au in the energy range 0.7 to 8 ev and the Breit-Wigner theory is excellent. All the level parameters can be evaluated by combining these scattering data with the results of transmission experiments and the cross section for self-indication. The final results for the 4.9-ev Au level are: $J = 1$, $\Gamma = 0.172$ ev, $\Gamma_N = 0.0211$ ev, $R_{J=1} = 1.03$ barns$^{1/2}$, $R_{J=2} = 0.917$ barn$^{1/2}$, where Γ is total level width, Γ_N is neutron width at exact resonance, and R is effective nuclear radius. (auth)

5921

Rochester Univ.

THE INTERACTION OF A CHARGED PI MESON WITH THE DEUTERON. W. B. Cheston. Aug. 1951. 34p. (NYO-903)

The radiative absorption, charge-exchange scattering, elastic and inelastic scattering of a π^+ meson by the deuteron are calculated in conventional weak-coupling theory for the pseudoscalar field with both direct and gradient coupling. The nucleon-nucleon interaction is treated phenomenologically and the "impulse" approximation employed. The behavior of the ratio $\sigma_{\text{non-radiative}}/\sigma_{\text{radiative}}$ for the PS theory is different from that for the PV theory. The charge-exchange scattering of a PS meson exhibits a minimum for forward scattering for both types of coupling but otherwise mirrors the behavior of the charge-exchange cross section for a neutron target. The elastic and inelastic scattering cross sections are comparable for an incident 25-Mev meson (and small energy transfers to the deuteron are highly favored) in contrast to the case in which the target nucleus is more complex. (auth)

5922

Columbia Univ.

PARAMAGNETIC SCATTERING OF NEUTRONS BY MnF_2 AND MnO. (abstract) P. J. Bendt, L. J. Rainwater, and W. W. Havens, Jr. Apr. 26, 1951. 2p. (CUD-67; DR-1593)

The report is reproduced here in its entirety.

Ruderman (Phys. Rev. 76, 1572 (1949)) obtained experimental confirmation of paramagnetic neutron scattering, and checked the free-ion integral form factor derived by Halpern and Johnson, (Phys. Rev. 55, 898 (1939)) by making neutron transmission measurements on MnF_2 and MnO. Shull et al. (ORNL 481) have confirmed the free-ion differential form factor, and have studied magnetic reflections from MnO and other manganese compounds when these were cooled below their Curie temperature.

The neutron scattering experiments to be described were for the purpose of studying the intermediate situation, when the magnetic ions are neither entirely uncoupled, nor rigidly locked in an antiferromagnetic array. In the analysis of the results, an attempt has been made to separate inelastic effects from coherent effects due to short-range ordering of the ion spins.

The parameters which could be varied in this experiment were the angle of scattering, 18 or 33°; the neutron wavelength, 1 to 55 A, determined by the Columbia Neutron Velocity Selector; the strength of the exchange coupling between Mn^{++} ions, which is stronger in MnO than in MnF_2; and the sample temperatures, between 107 and 610°K.

5923

Argonne National Lab.

IONIZATION IN AIR FROM BETA-RAY POINT SOURCES; PROGRESS REPORT, p.163-7 of DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH; QUARTERLY REPORT, AUGUST, SEPTEMBER, OCTOBER, 1950. R. Munick and R. K. Clark. [nd] 5p. (ANL-4531(p.163-7))

Air-absorption curves have been computed for P^{32} and C^{14} radiation on the assumption that scattering in the air is negligible. Reasons for discrepancy between calculated and experimental values are considered. 3 figures.

5924

INVESTIGATION OF THE SPATIAL DISTRIBUTION OF THE BREMSSTRAHLUNG OBTAINED WITH A 5-MEV BETATRON. H. Kulenkampff, M. Scheer, and R. Schittenhelm. Z. Physik 129, 202-18(1951) Feb. 13. (In German)

Using the betatron of the Siemens-Reiniger plant in Erlangen, Germany, in which the issuing electrons form a well-defined beam, measurements were made of the angular distribution of the bremsstrahlung from anticathodes of various materials (Al, Cu, W) and thicknesses; the nuclear photoeffect of Be served for detecting the radiation. The shape of the distribution curves and the relative-intensity values are in good agreement with the requirements of the theory of radiation, provided the multiple scattering of electrons is taken into account when the layers are not very thin. (auth)

5925

COMPOUND SCATTERING OF PROTONS AND DEUTERONS. Torben Huus. Kgl. Danske Videnskab., Mat. fys. Medd. 26, No. 4, 16p. (1951).

Measurements have been made, by means of a deflection chamber and an oscillograph, of the distributions of scattering angles when protons and deuterons penetrate thin foils of Au, Be, or Cu. The experimental method is explained, and several oscillograms are shown. The measured half widths are plotted as a function of the mean energy of the scattered particles. Another graph shows the distribution of the projected deflection angle as determined by means of a photographic plate. The theory of compound scattering is summarized, and it is concluded that the results of the experiments seem to be in good accord with the theory, both as regards the absolute values of the scattering angles and their dependence on the different parameters.

5926

ANGULAR DISTRIBUTION OF 3.1-MEV NEUTRONS SCATTERED BY PROTON. Yukiyasu Oda, Jyumpei Sanada, and Shōtaro Yamabe. J. Phys. Soc. Japan 6, 153-6(1951) May–June.

The angular distribution of fast neutrons scattered by protons in paraffin, paraffin and graphite, water, and quartz and silicon have been measured. Even though the present results have some large errors, it can be concluded that forward scattering of 3.1-Mev neutrons by protons is not inconsistent with the isotopic scattering. Results are tabulated.

5927

PHOTONS AND ELECTRONS. K. H. Spring. New York, John Wiley & Sons, Inc., 1950. 108p.

This book essentially contains an abstraction of the more comprehensive texts on the theory of radiative processes. It starts with a very brief outline of fundamental processes and then proceeds to discuss the pertinent phenomena. The subjects discussed are: photoelectric effect, Compton effect, bremsstrahlung, Cherenkov radiation, pair production, and some considerations on soft showers in cosmic rays. This book is a very useful aid to the student in high-energy physics who does not have sufficient training to make use of the complete quantum-mechanical treatment of radiation processes, but who wants to become acquainted with the theoretical predictions and the somewhat meager experimental data. A more complete review by W. K. H. Panofsky has appeared in Rev. Sci. Instruments 22, 274(1951) Apr.

5928

ON THE SCATTERING OF FAST NEUTRONS FROM Li-D REACTIONS. Tetsuo Wakatsuki and Kenzo Sugimoto. J. Phys. Soc. Japan 6, 151-63(1951) May-June.

Total scattering cross sections for 37 elements have been measured for heterogeneous fast neutrons of mean energy 6.5 Mev. Irregular variations of cross sections with atomic weights were observed at magic number nuclei but they were not all smaller than the neighboring nuclei as is the case for inelastic scattering or capture processes. It is probable that elastic scattering cross sections become large at those nuclei. Other large irregular variation of cross section was found at Ti. (auth)

5929

HIGH ENERGY BREMSSTRAHLUNG AND PAIR PRODUCTION. J. W. DeWire and L. A. Beach. Phys. Rev. 83, 476-7(1951) July 15. (Letter to the editor)

The energy spectrum of photons from the Cornell synchrotron has been observed under various conditions with a magnetic pair spectrometer. The spectrum from a thin synchrotron target in the form of a ½-mil W ribbon is shown. The spectrum from a 40-mil W wire was also observed. Relatively fewer high-energy photons appeared in the thick-target spectrum. The data fit the curve predicted by the Bethe-Heitler theory within the statistical errors. Experimental data on energy sharing between members of electron pairs also agree with the Bethe-Heitler differential cross-section curve.

5930

ABSORPTION OF 280-MEV PHOTONS. J. W. DeWire, A. Ashkin, and L. A. Beach. Phys. Rev. 82, 447(1951) May 1. (Letter to the editor)

Total cross sections for 280-Mev photons in Be, Al, Cu, Sn, Pb, and U have been determined by measuring the transmission through samples placed in the bremsstrahlung beam from the Cornell 300-Mev synchrotron.

5931

DISTRIBUTION OF ENERGY LOSS OF ELECTRONS IN ALUMINUM. R. D. Birkhoff. Phys. Rev. 82, 448-9(1951) May 1. (Letter to the editor)

The conversion electrons of Ba^{137} have been examined before and after passing through a thin foil (13.4 mg/cm^2) of Al by means of a β-ray spectrograph. Calculations of the areas under the K lines with and without the foil indicate a loss of about 23% of the incident electrons due to scattering out of the beam. The width of the energy-loss distribution is considerably greater than predicted by theory.

5932

SCATTERING OF NEUTRONS BY FERROMAGNETIC CRYSTALS. R. G. Moorhouse. Proc. Phys. Soc. (London) 64A, 207-8(1951) Feb. (Letter to the editor)

A theoretical investigation was made of inelastic magnetic scattering of neutrons, with wavelengths greater than the Bragg reflection wavelength, by a ferromagnetic crystal such that exchange energy is lost by the scatterer and gained by the neutrons. This is based on the idea that at temperatures not too far below the Curie point, where there are an appreciable number of disoriented atomic moments within a domain, some of the disoriented electron spins may be reoriented during scattering into the direction of magnetization. Bloch spin wave functions were used to provide a simple model of a ferromagnetic with just one magnetic electron per atom. The possibility of observing this effect as a test of the Bloch model is considered.

5933

THE ANGULAR DISTRIBUTION OF 3-MEV NEUTRONS SCATTERED BY PROTONS AND BY DEUTERONS. W. F. Caplehorn and G. P. Rundle. Proc. Phys. Soc. (London) 64A, 546-53(1951) June.

The angular distribution of scattering of 3-Mev neutrons by protons and by deuterons has been investigated with a Wilson cloud chamber. The results reveal an almost isotropic distribution for neutron-proton scattering and a strongly anisotropic distribution in the case of neutron-deuteron scattering. The experimental results are compared with the theoretical curves of Buckingham and Massey for the scattering of 2.5-Mev neutrons by deuterons. (auth)

5934

PRIMARY SPECTRUM OF FAST NEUTRONS FROM A Ra α + Be SOURCE AND THEIR INELASTIC COLLISIONS IN Pb. PART II. F. G. Houtermans and M. Teucher. Z. Physik 129, 365-8(1951) Mar. 20. (In German)

Fast neutrons from a Ra α + Be source traversed 7 cm of Pb and acted on a photographic emulsion; from a study of the recoil protons the spectrum of the neutrons was determined and conclusions were drawn on the inelastic scattering of neutrons in Pb. (auth)

5935

SECONDARY ELECTRON EMISSION GENERATED BY 1 MEV AND 2 MEV X RAYS. C. W. Wilson and B. J. Perry. Brit. J. Radiology 24, 293(1951) May. (Letter to the editor)

An examination has been made of the dependence on atomic number of the secondary electron emission generated by 1- and 2-Mev x rays from a Van de Graaff electrostatic generator. There is very little difference between the results for radium γ rays and those for the 2-Mev x rays. With these radiations the forward emission from the heavy metals is a

little less than that from light-atom materials. Minimum emission for intermediate atomic numbers is still observed for the 1-Mev radiation, but in this case the minimum is less pronounced and the emission from heavy metals considerably exceeds that from light-atom materials.

5936
RELATIVE BACK-SCATTERING OF ELECTRONS AND POSITRONS. William Miller. Phys. Rev. 82, 452-3(1951) May 1. (Letter to the editor)

A new estimation of the backscattering coefficients, β^- and β^+, for electrons and positrons has been made. This evaluation is based on relativistic cross sections. The result indicates that differences in single scattering alone may well be responsible for observed differences in backscattering.

5937
INELASTIC SCATTERING OF COLD NEUTRONS. P. A. Egelstaff. Nature 168, 290(1951) Aug. 18. (Letter to the editor)

The gain of energy of cold neutrons on being scattered by crystalline materials has been investigated with a beam of Pb-filtered neutrons of maximum energy 0.0026 ev from the Harwell pile. Comparison of the transmission of a LiF plate before and after scattering was used as a measure of energy gain. The elements used as scatterers were H, Be, V, Se, Mo, and Fe. In the case of hydrogenous media, the presence of inelastic scattering is observable only with the thicker samples. In crystalline materials, the scattering cross section at neutron wavelengths greater than the Bragg limit is made up of inelastic scattering due to thermal vibrations and elastic incoherent scattering due to spin and isotope effects.

5938
THE INELASTIC SCATTERING OF FAST NEUTRONS. M. A. Grace, L. E. Beghian, G. Preston, and H. Halban. Phys. Rev. 82, 969(1951) June 15. (Letter to the editor)

The values of the energy levels and cross sections for inelastic scattering of 2.5-Mev neutrons by Be, Cr, Cu, F, Fe, Mg, and S are given. The absolute γ-ray yield from the excited nuclei due to a known fast-neutron flux was investigated with a pair of calibrated G-M counters operated in coincidence. The energy of the γ radiation was determined by the method of Bleuler and Zunti (Helv. Phys. Acta 19, 375(1946)) from the absorption in Al of the secondary electrons produced by a polystyrene radiator. The absolute value of the neutron flux was measured with a proton-recoil ionization chamber.

5939
RESONANT NUCLEAR SCATTERING OF GAMMA-RAYS: THEORY AND PRELIMINARY EXPERIMENTS. P. B. Moon. Proc. Phys. Soc. (London) 64A, 76-82(1951) Jan.

Since the lower excited states of nuclei have very small widths ($\ll 1$ ev), resonant scattering of γ rays requires precise matching of the energy available from the γ ray with the energy necessary to excite the scattering nucleus. The present paper reports a theoretical and experimental study of the possibility of producing the resonance with the aid of the Doppler effect, the source being made to move toward the scatterer with an appropriate velocity. Preliminary experiments have been made with the 0.411-Mev radiation from the nucleus Hg^{198}, the source being carried by a high-speed rotor up to a speed of about 7×10^4 cm/sec and the scatterer being liquid mercury (10% Hg^{198}). A small but apparently significant increase of scattering was found, corresponding to an intrinsic width of the excited state of the order of 10^{-5} ev. No such increase was observed with Ta^{181} γ rays scattered from tantalum carbide. The negative result for Ta^{181} and the positive result for Hg^{198} are consistent with the latest information about the lifetimes of the excited states concerned, viz., 1.1×10^{-8} sec for Ta^{181} and less than 2×10^{-10} sec for Hg^{198}.

5940
OBSERVATIONS ON THE MULTIPLE SCATTERING OF IONIZING PARTICLES IN PHOTOGRAPHIC EMULSIONS.—PART II. THE SCATTERING OF POSITRONS AT 105 AND 185 MEV. M. G. K. Menon, C. O'Cellaigh, and O. Rochat. Phil. Mag. 42, 932-51(1951) Aug.

The coordinate method has been used to measure the multiple scattering in Ilford G5 emulsions of positrons of nominal energy 113 and 196 Mev. The energies of the positrons corrected for loss by ionization and radiation are calculated to be 105 and 185 Mev, respectively. The experimental distributions of second differences have been compared with those predicted by the theory of Molière (1947, 1948) and the agreement found to be very satisfactory. Methods of minimizing the effects of spurious scattering and of taking into account the influence of distortion are discussed. Values are found for the scattering constant which are in good agreement with those calculated from the theory of Molière. A discussion of these results has been given in a previous paper of this series (Gottstein et al. 1951). A mathematical treatment is given in the Appendices: (I.) the correlation existing between successive second differences, (II.) the distribution of second differences when measured in the presence of spurious scattering, and (III.) a possible method for correcting second differences which have been affected by a large angle scattering. (auth)

RADIATION EFFECTS

5941
A STUDY OF IRRADIATED CRYSTALS WITH A GEIGER POINT COUNTER. J. Kramer. Z. Physik 129, 34-44(1951) Jan. 29. (In German)

Many freshly crushed crystals exhibit an activity that can be recorded by a Geiger point counter. In certain crystals it is generated through an irradiation with x rays or ultraviolet light, while in freshly crushed fluorspar even visible or infrared light produces a short-lived activity. Thus, unlike fluorescence, where absorbed radiating energy reappears as a radiation, the phenomenon studied here is an emission of particles. In many substances its intensity can also be increased through the action of a glow discharge. (auth)

RADIOACTIVITY

5942
Radiation Lab., Univ. of Calif.
MASS DESIGNATION OF THE 51.5 MIN–Tc ISOMER. (abstract). H. A. Medicus and Harry T. Easterday. [nd] 1p. (UCRL-1439)

The report is reproduced here in its entirety.

By proton bombardment of molybdenum of natural isotopic composition about a dozen Tc activities are produced which, with a few exceptions, could all be ascribed to specific isotopes. One exception is the Tc isomer of 51.5-min half life and 34.4-kev transition energy (Medicus, Preiswerk, and Scherrer, Helv. Phys. Acta 23, 299(1950)) which is relatively difficult to detect due to its low energy and because it is masked by the 52.5-min positron emitter, Tc^{94}. By bombardment of enriched Mo isotopes with protons of 9.5 Mev energy in the 60-in. cyclotron and then by using a lens spectrometer to compare the intensity of the L-line of the isomer with characteristic conversion lines of the known isotopes, it could be proved that this isomer belongs to Tc^{96} whose ground state has a half life of 104 hr. This isomer was also produced by 4-Mev protons from the Berkeley electrostatic generator on natural molybdenum. This also confirms the previous results (Medicus,

Preiswerk, and Scherrer, ibid.) that the isomer is not connected with the positron emitter Tc^{94} since the (p,n) threshold to produce the latter activity requires a proton energy of 5.1 Mev.

5943

Atomic Energy Research Establishment, Harwell, Berks (England)

SHORT-LIVED ANTIMONY FISSION PRODUCTS AND THEIR DESCENDANTS; by G. B. Cook. June 22, 1951. 5p. (AERE C/R-729)

Sb isotopes of 45-sec, ~2-min, 4.2-min, and ~20-min half life have been found in U fission. Chemical separation of the Sb was achieved rapidly by electrolytic formation of stibine (SbH_3). Te and I descendants were studied to aid in identification of mass numbers of the Sb isotopes. The 20-min activity was assigned to Sb^{131}. Results are in good agreement with the more complete recent measurements of Pappas (Phys. Rev. 81, 299(1951)).

5944

Vanderbilt Univ.

THE MEASUREMENT OF THE In^{115*} CONVERSION COEFFICIENT WITH A SCINTILLATION SPECTROMETER; by Thomas B. Cook, Jr., and Sherwood K. Haynes. 35p. (ORO-46)

The internal-conversion coefficient of the 0.39-Mev isomeric transition of In^{113} has been determined by comparison with the theoretical K-conversion coefficient for Hg^{198} given by Rose et al. (Phys. Rev. 83, 79(1951)). A scintillation spectrometer was used to measure the pulse-height distribution of conversion and Compton electrons. The comparison method is described. The total conversion coefficient α was found to be 0.55 ± 0.03. Thus the K-conversion coefficient is 0.46 ± 0.03, assuming the K to L conversion ratio of 5.4 ± 0.8 as determined by Lawson and Cork (Phys. Rev. 57, 982(1940)). This value is in good agreement with the value of 0.47 from Rose's tables for magnetic 2^4-pole radiation.

5945

Brookhaven National Lab.

TWO-STEP ISOMERIC TRANSITION IN Hf^{179m}. E. der Mateosian and M. Goldhaber. July 2, 1951. 6p. (AECU-1594)

Enriched isotopes Hf^{176}, Hf^{177}, Hf^{178}, and Hf^{179} were irradiated in the Brookhaven reactor. A highly internally converted transition of 160 kev and a weakly converted transition of 215 kev were observed with a scintillation spectrometer. The latter appeared most intense in $Hf^{178} + n$. The γ rays were found to decay with a half life of 19 sec. A tentative decay scheme suggested, compatible with existing knowledge and shell theory, is $h_{9/2} \xrightarrow{160\ kev} p_{3/2} \xrightarrow{215\ kev} p_{1/2}$.

5946

[Argonne National Lab.]

BETA-INNER BREMSSTRAHLUNG ANGULAR CORRELATION. (abstract) Theodore B. Novey. June 1951. 2p. (AECU-1462; UAC-398)

The report is reproduced here in its entirety.

An experimental study has been made of the angular correlation between the beta particles emitted in the decay of P^{32} and the radiation emitted during the creation-emission process.

The source was mounted at the center of a 7-in. diam plastic vacuum chamber. The beta detecting stilbene crystal was mounted on a light guide on a 5819 photomultiplier tube so that the crystal face was inside the vacuum covered only with 0.2 mg/cm² aluminum foil. The source, vacuum chamber, and beta detector rotated as a unit with respect to a NaI(Tl) gamma detecting crystal, also mounted on a 5819 photomultiplier. The relatively slow NaI pulses were double delay line shaped, giving a pulse of about 15% of the original height, but with a pulse width of 0.08 μsec. With this arrangement it was possible to count low-energy gamma rays to about 40 kev with almost 100% efficiency and yet have a fairly fast coincidence-resolving time of 0.11 μsec.

The results were compared with the angular correlation predicted by the theory of Knipp and Uhlenbeck (Physica 3, 425(1936)), and Bloch (Phys. Rev. 50, 272(1936)), as extended by Wang Chang and Falkoff (Phys. Rev. 76, 365 (1949)). The correlation was averaged over the beta spectrum of P^{32} and gave excellent agreement with the experimental coincidence rate as a function of angle over the entire range of measurement from 30 to 180°.

5947

Brookhaven National Lab.

DECAY OF 10.7-MIN Co^{60m}. M. Deutsch and G. Scharff-Goldhaber. July 19, 1951. 4p. (AECU-1591)

The decay of Co^{60m} was studied by means of proportional and scintillation counters. The 10.7-min isomeric state was found to decay mainly by a highly converted isomeric transition of 58.9 kev to the ground state, 5.2-yr Co^{60}, which decays by emission of a 0.32-Mev β to the second excited (2.50-Mev) state of Ni^{60}. The 10.7-min Co^{60} was also found to decay by emission of a 1.56-Mev β to the first excited (1.33-Mev) state of Ni^{60}, the branching ratio of direct β decay to the isomeric transition being $2.8 \pm 0.6 \times 10^{-3}$. Spin 2 and even parity are assigned to the 10.7-min state. The ratio of the neutron-capture cross sections for production of the two states of Co^{60} is $\sigma_{5.2yr} / \sigma_{10.7min} = 1.4 \pm 0.6$.

5948

Brookhaven National Lab.

DISINTEGRATION SCHEME OF Lu^{176m}. (abstract) G. Scharff-Goldhaber, E. der Mateosian, and J. W. Mihelich. Aug. 15, 1951. 1p. (AECU-1605)

The report is reproduced here in its entirety.

Lu^{176m} is known to decay with a half life of 3.7 hr (K. Way et al, Natl. Bur. Standards (U.S.) Circ. 499) emitting beta particles of 1.0 to 1.2 Mev maximum energy, whereas the ground state of Lu^{176} has a beta spectrum with a maximum energy of 0.2 to 0.4 Mev and a half life of 2.4×10^{10} yr. A search was therefore made, with a sensitive scintillation spectrometer, for a γ ray of 0.6 to 1 Mev due to an isomeric transition of Lu^{176m}. No such γ ray was observed, indicating that the spin difference between ground state and excited state is at least 5. However, a strongly converted (89.0 + 0.5 kev) γ ray was found in the 3.7-hr Lu isomer following the β ray (1.1 Mev) with <1 μ sec delay, with a K/L ratio of 0.10 ± 0.06, indicating an E2 transition. The spin and parity of the first excited state in Hf^{176} are thus 2+, in agreement with a rule for even-even nuclei recently pointed out by Goldhaber and Sunyar (Phys. Rev. 83, 906-18 (1951) Sept. 1). Beta rays of 1.2 Mev going directly to the ground state of Hf^{176} were also found. Spin and parity of Lu^{176m} are assigned as 1+.

5949

Tennessee Univ.

A STUDY OF SELF-ABSORPTION IN THE COUNTING OF LOW ENERGY BETA PARTICLE EMITTING SOLIDS; FINAL REPORT. George K. Schweitzer, James W. Nehls, and Bernard R. Stein. June 30, 1951. 54p. (ORO-36)

Theoretical. An approximate equation is derived for the ratio A_m/A_t (activity observed/true activity) from the activity vs. surface-density curve of low-energy β emitters. Three methods — equational, graphical, and extra absorber — are explained for finding A_t, the specific activity per milligram. Scattering Effects in the Self-Absorption of S^{35} β Particles. An absorption curve of S^{35} β particles, with Al absorbers placed directly on top of the sample to simulate

self-absorption conditions, was found to be not exponential below 5 mg/cm² of absorber. Since self-absorption relations were derived, in the preceding theoretical section on the assumption of exponentiality, a self-absorption curve for samples with the activity homogeneously distributed was synthesized, and a correction factor was derived to correct the synthesized curve to exponentiality. Experimental absorption curves run on radioactive Sr, Ba, and Pb sulfates were in good agreement with the corrected synthesized curve. Variables in the Self-absorption of Low-energy Beta Particles. It is shown that the average atomic number of the sample, the Atomic number of the backing, the sample-to-tube distance, and the tube window thickness affect the per cent specific activities, particularly those of the low surface-density samples. These factors make extrapolation to zero surface density somewhat indefinite and subject to variation. Self-absorption Phenomena in the Measurement of the Radioactivity of Ni^{63}. The self-absorption characteristics of Ni^{63} are quite regular, behaving as would be predicted from self-absorption data on other nuclides. Two methods of sample preparation seem to give good results, that of electroplating and that of precipitation of nickel dimethylglyoxime. An average mass absorption coefficient of 1.48 cm²/mg was observed.

5950

Vanderbilt Univ.

THE ELECTRON SPECTRUM OF Sn^{113} AND In^{113}. (abstract) D. A. Thomas and S. K. Haynes. [nd] 1p. (AECU-1465)

The report is reproduced here in its entirety.

The electron spectrum of Sn^{113}-In^{113} has been studied from 4 kev to 500 kev on a medium-resolution magnetic-lens beta-ray spectrometer. Nylon windows approximately 18 and 36 μg/cm² were used. The former permitted a few of the L Auger electrons at 4 kev to be counted. A thin electroplated source of Sn^{113} produced from electromagnetically separated Sn^{112} irradiated in the Hanford Pile gave K Auger electron peaks very little broader than the K conversion line of the In^{113*} 0.39-Mev gamma ray. The energies of both the Auger peaks and K conversion line were within experimental error (~1%) of previously reported values. No evidence of a K conversion line corresponding to an 0.085-Mev gamma ray was found. The ratio of the total K-Auger-electron yield to the K-conversion-electron yield was 0.54 with the thinner window. The 20-kev K-LL peak was only 3.8% less intense for the thicker window. The Auger-K ratio depends on the fluorescent yield, the ratio of L to K captures in Sn^{113}, the conversion coefficient of the 0.39-mev gamma ray, the fraction of disintegrations going directly to the ground state, and the window transmission.

5951

Mississippi State Coll. and Vanderbilt Univ.

ABSORPTION STUDIES ON Sn^{113} and In^{113*}. (abstract) H. C. Thomas, S. K. Haynes, and C. D. Broyles. [nd] 1p. (AECU-1466)

The report is reproduced here in its entirety.

Previous experiments by others on 105-day Sn^{113} have shown it decays by orbital capture to In^{113*} (0.39 Mev, N_e/N_γ = 2.3, 104-min half life N_K/N_L = 5.4). The half life, energy, and K-L ratio indicate that 104-min transition must be largely magnetic 2^4 pole. The above value of N_e/N_γ is much too high for such a transition. Furthermore, disagreement exists as to whether an 0.085-Mev transition precedes the 104-min transition. In order to investigate the discrepancies a counter was constructed whose absolute efficiency for beta rays and for gamma-ray energies below 0.5 Mev was approximately known. The source was electromagnetically separated Sn^{113} which was irradiated in the Hanford Pile. Absorption measurements in Pb show that 0.085-Mev gamma rays, if present, occur in less than 1% of the disintegrations. Comparison of the extrapolated electron and 0.39-Mev gamma-ray intensities indicates that the total conversion coefficient is approximately 0.29 ± 0.1 which is in better agreement with the predicted value of 0.53 for magnetic 2^4 pole radiation than the previous value.

5952

[Argonne National Lab.]

HALF-LIFE OF PLUTONIUM-240 BY DETERMINATION OF ITS URANIUM-236 DAUGHTER. M. G. Inghram, D. C. Hess, P. R. Fields, and G. L. Pyle. [nd] Decl. July 9, 1951. 2p. (AECD-3193; [ANL-WMM-647])

The report is reproduced here in its entirety.

A new measurement of the Pu^{240} half life has been made using a technique which depends on the growth of the uranium daughters from a plutonium sample of known isotopic composition. The decays involved in this experiment are:

$$(1)\ Pu^{239} \xrightarrow[a]{24{,}410\ \text{yr}^*} U^{235} \xrightarrow[a]{7\times10^8\ \text{yr}}$$

$$(2)\ Pu^{240} \xrightarrow[a]{\sim 6000\ \text{yr}^\dagger} U^{236} \xrightarrow[a]{\sim 2\times10^7\ \text{yr}^\ddagger}$$

Since the time necessary to complete the experiment was short in comparison to the half lives involved, the following simplified analytical expression can be obtained for the Pu^{240} half life:

$$T_{1/2}\ (Pu^{240}) = \frac{\text{Moles of } U^{235}}{\text{Moles of } U^{238}} \times \frac{\text{Moles of } Pu^{240}}{\text{Moles of } Pu^{239}} \times T_{1/2}(Pu^{239})$$

The half life thus obtained depends on the isotopic ratios of the uranium daughters and of the plutonium parents as determined by the mass spectrometer, and on the known half life of Pu^{239}. Previous measurements of the Pu^{240} half life have been dependent on the Pu^{239} half life and on the ratio of the plutonium isotopes, but have also been subject to the errors inherent in specific activity measurements.

The plutonium used for this experiment was chosen because it contained a relatively large amount of Pu^{240}, and because it had been purified several years earlier with respect to the other heavy elements. After further preparation an analysis on the Alpha Differential Pulse Analyzer indicated the uranium fraction was sufficiently free of plutonium for mass spectrometric determinations.

The calculation of the half life of Pu^{240} involved two experimental errors. (1) The error in the half life of Pu^{239} which is given by Westrum* as ±0.3%; (2) the error in the mass spectrometric measurements of the isotopic ratios which is about ±0.3%. It should be noted that the usual mass discriminations inherent in a mass spectrometer cancel in the present case. Substituting in the analytical expression, the values obtained on the mass spectrometer for the isotopic ratios of Pu^{240}/Pu^{239} and U^{235}/U^{238} and the value $T_{1/2}^{239}$ = 24,410 yr,* gives the half life of Pu^{240} as 6580 ± 40 yr. This value and its limits of error is to be compared with those of 6240 ± 120 yr,§ 6850 ± 150 yr,¶ and 6650 ± 150 yr,¶ as determined by specific activity measurements.

*E. F. Westrum, Jr., National Nuclear Energy Series, Volume 14B, "The Transuranium Elements: Research Papers," Paper 22.80, McGraw-Hill Book Company, Inc., New York, 1949.

†R. A. James, A. E. Florin, H. H. Hopkins, Jr., and A. Ghiorso, ibid., Paper 22.8

‡A. H. Jaffey and H. Diamond, to be published.

§E. F. Westrum, Jr., to be published.

¶S. G. Thompson, K. Street, Jr., A. Ghiorso, and F. L. Reynolds, to be published.

5953
ON THE DECAY SCHEME OF IONIUM AND RADIOTHORIUM. I. Estulin. Uspekhi Fiz. Nauk 44, 269-74(1951) June. (In Russian)

The problem of the decay schemes of Th^{230} and Th^{228} is discussed. 13 references.

5954
DECAY OF THE MERCURY ISOMERS Hg^{197}. O. Huber, F. Humbel, H. Schneider, A. de Shalit, and W. Zünti. Helv. Phys. Acta 24, 127-52(1951) Apr. 10. (In German)

A genetic relationship was shown to exist between the isomers Hg^{197m} (23-hr) and Hg^{197} (65-hr). Conversion coefficients of the corresponding γ transitions were determined by lens-spectrometric experiments and by coincidence measurements of the conversion electrons using Geiger counters. With the aid of a setup in which coincidences were produced within the spectrometer, the transitions from the excited levels of Au^{197} were observed; the isomer Au^{197m} (7.4-sec) decays by emission of three quanta in cascade. A decay scheme for Hg^{197} is proposed.

5955
PRODUCTION OF HELIUM BY ALPHA PARTICLES FROM RADIUM IN SOLUTION. F. A. Paneth. J. chim. phys. 48, 163-7(1951) Mar.-Apr. (In French)

A setup for accurate determination of the specific α activity of Ra is described, in which the quantity of He liberated from a solution of $RaCl_2$ and freed from other gases is measured with the aid of Pirani gages. Actual measurements, using a very pure preparation of $RaCl_2$, will be made in the near future. A test will be made of Kohman's contention that the accepted value 3.7×10^{10} α particles/sec/g Ra should be replaced by 3.6×10^{10}.

5956
MAXIMUM AND MEAN ENERGY OF THE RECOIL NUCLEUS IN THE BETA-DECAY OF Kr^{89}. O. Kofoed-Hansen and P. Kristensen. Kgl. Danske Videnskab. Selskab. Mat.- fys. Medd. 26, No. 6, 20p.

Experiments on the energy of the recoil nucleus in the β decay of Kr^{89} are described. This maximum energy was found to be 115 ± 5 ev, in good agreement with the previously measured maximum β energy. The average value of the recoil energy divided by the charge of the recoil atom was determined as 58 ± 2 ev. In connection with the latter experiment the relative yield of mass numbers 89 and 88 in the fission of U was measured, with the result y_{89}/y_{88} = 1.5 ± 0.2. At the same time the half life of Kr^{89} was determined as 3.14 min. The results support a forward neutrino emission with respect to the direction of emission of the β particle, in agreement with the assumption that the decay is forbidden. (auth)

5957
ON THE γ RADIATION OF Br^{82}. Pierre Hubert and Jeanne Laberrigue-Frolow. Compt. rend. 232, 2420-1 (1951) June 25. (In French)

The γ spectrum of Br^{82}, measured with a spectrometer carrying a thick magnetic lens, revealed the 7 lines reported by Siegbahn et al. (Phys. Rev. 76, 1263(1949)) and an 8th line, of 1453 ± 6 kev, following the 7th one; its intensity is 0.25 ± 0.03 times that of the 7th (1306-kev) line.

5958
ANGULAR CORRELATION OF SUCCESSIVE GAMMA-RAY QUANTA IN Cu^{65}. T. Wiedling and Allan Carlsson. Phys. Rev. 83, 181-2(1951) July 1. (Letter to the editor)

Measurements have been made of the angular correlation between the 0.37- and 1.12-Mev γ rays in cascade in the disintegration of Ni^{65} to Cu^{65}. The angular-correlation spectrometer used consisted of two scintillation counters with 1P21 multipliers and anthracene crystals. The coincidence circuit had a resolving time of about 0.19 μsec. The experimental points lie very close to the angular-correlation curve calculated for dipole-quadrupole radiation. Spins of 9/2 and 7/2 for the 1.49-Mev state in Cu^{65} are eliminated.

5959
THE PHOTO-DISINTEGRATION OF OXYGEN INTO TWO ^8Be NUCLEI. F. K. Goward and J. J. Wilkins. Proc. Phys. Soc. (London) 64A, 94(1951) Jan. (Letter to the editor)

Continuing the work reported in a recent note (Goward and Wilkins, Proc. Phys. Soc. (London) 63A, 1171(1950)), measurements have now been made on some 200 $O^{16} \rightarrow 4He^4$ photodisintegration stars. It has now been established that direct disintegrations into $2Be^8$ nuclei do occur without formation of the usual intermediate C^{12} nuclei. Six observed stars were clearly formed by initial disintegration into 2 ground-state Be^8 nuclei by the reaction $O^{16} + h\nu \rightarrow 2Be^8$. These stars are readily recognized by the "V" tracks of the α particles finally produced.

5960
DETERMINATION OF FISSION AND NEUTRON YIELDS, AND THE AVERAGE NEUTRON ENERGY IN THE PHOTODISINTEGRATION OF URANIUM. F. K. Goward, E. J. Jones, H. H. H. Watson, and D. J. Lees. Proc. Phys. Soc. (London) 64A, 95-6(1951) Jan. (Letter to the editor)

The fission and neutron yields in the photodisintegration of U have been measured using an ionization chamber with Al walls of variable thicknesses, whose calibration has been carefully studied. The approximate average energy of the neutrons has been determined. The degree of fit between experiment and a simple "two-group" diffusion theory is shown on a graph. The results obtained in the experiments were (1) 1 mg of U gives 24.2 ± 2 fissions/r; (2) 1 mg of U gives 255 ± 25 neutrons/r; (3) $\int_0^{23} \sigma dE = 1.5 \pm 0.3$ Mev-barns for the fission yield; (4) $\int_0^{23} \sigma dE = 11.5 \pm 3$ Mev-barns for the neutron yield; (5) the mean energy of the neutrons emitted is 1.8 ± 0.5 Mev.

5961
GAMMA-RADIATION FROM I^{132}. Fred C. Maienschein, Joe Keagy Bair, and William B. Baker. Phys. Rev. 83, 477-8(1951) July 15. (Letter to the editor)

Energy measurements of the I^{132} γ-ray spectrum were made by three methods: a single NaI crystal, two complete single-crystal spectrometers connected in coincidence, and a Hofstadter-type two-crystal spectrometer. Single-crystal measurements yielded γ rays with energies of 0.67, 1.41, and 1.99 Mev, and Hofstadter-type spectrometer experiments were in good agreement (0.69, 1.41, and 2.02 Mev, plus an indication of a weak line at 0.8 Mev). Relative intensities of 37, 4, and 1, respectively, were obtained. The first two γ rays were in coincidence, with the third apparently representing the cross-over transition.

5962
DISINTEGRATION OF Ce^{143} AND Pr^{143}. Evani Kondaiah. Phys. Rev. 83, 471(1951) July 15. (Letter to the editor)

The β-ray spectrum of pile-irradiated Ce consisted of several electron peaks superimposed on a complex continuous β spectrum. No measurable number of positrons could be observed in the spectrometer with a positron baffle. The photospectrum taken in the same spectrometer showed several photolines. Fermi analysis of the β-ray spectrum recorded within 24 hr after the sample was taken from the pile showed as many as five components and an indication of a sixth component. They are 1.37 ± 0.01 (Ce^{143}), 1.09 ± 0.02 (Ce^{143}), 0.86 (Pr^{143}), 0.57 (Ce^{141}), 0.42 (Ce^{141}), and 0.37 (Ce^{143}) Mev. Energies of internal-conversion electrons and photons from Ce^{143} and Ce^{141} are tabulated, and a decay scheme is proposed for Ce^{143} and Pr^{143}.

5963
THE $H\rho$ OF THE HIGH ENERGY INTERNAL CONVERSION ELECTRONS FROM THORIUM D. Walter L. Brown. Phys. Rev. 83, 271-4(1951) July 15.

The absolute $H\rho$ of the K internal conversion electrons from the 2.6-Mev γ-ray of ThD has been measured using a 180° magnetic spectrometer whose field was calibrated with the proton magnetic resonance. With a proton resonance frequency, vp, of 3.75 megacycles, corresponding to a field of 880 gauss and an electron radius, ρ, of 11.4 cm, the value $\nu p\rho = 42.528 \pm 0.008$ megacycle cm was obtained for the line. This is equivalent, through the proton gyromagnetic ratio, to an $H\rho = 9988._4 \pm 2$ gauss cm. (auth)

5964
TABLE OF ft VALUES IN BETA-DECAY. Arnold M. Feingold. Revs. Modern Phys. 23, 10-20(1951) Jan.

A table of ft products is presented and briefly explained. It is based on the isotope compilation of Seaborg and Perlman (Revs. Modern Phys. 20, 585(1948)) and subsequent literature to June 1, 1950. Approximately 250 references are listed.

5965
RADIOACTIVE ^{159}Dy. F. D. S. Butement. Proc. Phys. Soc. (London) 64A, 428(1951) Apr. (Letter to the editor)

Dy^{159} has been prepared in two ways: (1) by pile irradiation of dysprosium oxide in a neutron flux of 10^{12} cm^{-2}/sec and (2) by irradiation of terbium oxide by 9-Mev deuterons. The first sample showed a half life of 132 days and the second 136 days. Both emitted only electromagnetic radiations with energies of 6.6 and 44 kev, corresponding to the L and K x rays of terbium. Positron emission, if any, was less than 1 per 1000 disintegrations. It is concluded that the only long-lived product of neutron capture by dysprosium is Dy^{159}.

5966
MODES OF DISINTEGRATION OF IONIUM: AN INVESTIGATION USING β-SENSITIVE EMULSIONS. C. Joan D. Jarvis and M. A. S. Ross. Proc. Phys. Soc. (London) 535-45(1951) June 1.

Kodak NT 4 emulsion has been impregnated in a neutral solution of ammonium ionium oxalate. Observations of α-particle and internal-conversion electron tracks are interpreted in terms of excitation levels of the radium nucleus at about 70 kev (22% intensity) and at about 200 and 270 kev (combined intensity about 2%). A disintegration scheme is proposed which allocates the known γ ray of 68 ± 1 kev to the transition between the two highest levels. The results are reasonably consistent with recent α-ray magnetic analyses and γ-ray absorption measurements. (auth)

5967
SCINTILLATION STUDIES OF Os^{185}. Maurice M. Miller and Roger G. Wilkinson. Phys. Rev. 82, 981(1951) June 15. (Letter to the editor).

The γ and x radiations following K-capture in Os^{185} have been investigated by means of a single-crystal scintillation spectrometer. The photoelectron spectrum shows two peaks 0.65 ± 0.01 and 0.88 ± 0.01 Mev. A comparison of true areas under the two photopeaks shows the lower-energy γ ray to be 6.1 times as intense as the higher-energy one, due account being taken of the variation of the photoelectric cross section. For the x-ray measurements peaks were found at 60 kev, 26 kev, and then, with the gain increased by a factor of 6, at 10 kev. It would seem from this experiment that relative intensities of γ rays can be measured by scintillation-counter methods with at least the accuracy of ordinary spectrometer measurements; and, in addition, x rays down to 10 kev can be studied.

5968
SOFT RADIATIONS FROM ^{239}Pu. D. West and J. K. Dawson. Proc. Phys. Soc. (London) 64A, 586-7(1951) June. (Letter to the editor)

Soft radiations from Pu^{239} were studied. The majority of the radiation detected was L x radiation of U. A search for soft γ radiation was made using much stronger sources than were necessary for investigating the L x rays. Only very weak radiations were found, and a discussion is given as to their possible source.

5969
MEASUREMENTS ON SHORT-LIVED RADIOACTIVE KRYPTON ISOTOPES FROM FISSION AFTER ISOTOPIC SEPARATION. O. Kofoed-Hansen and K. O. Nielsen. Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 26, No. 7, 1-16(1951).

The decay schemes of Kr^{89}, Kr^{90}, and Kr^{91} have been investigated. The experimental arrangement is described briefly, and a reference is given for a more complete description. Kr^{89} (half life 3.18 min) decays by β emission (maximum β energy 4.0 ± 0.2 Mev) accompanied by a γ ray to 15.4-min Rb^{89}. Kr^{90} (half life 33 sec) decays by β emission (maximum energy ~ 3.2 Mev) and a γ ray to 2.74-min Rb^{90}. Kr^{91} (half life 10 sec) decays by β emission (maximum energy ~ 3.6 Mev) to the 100-sec and 14-min states of Rb^{91}. The decay schemes of the Rb daughter isotopes are also outlined.

5970
RADIOACTIVE SAMARIUM-145 AND PROMETHIUM-145. F. D. S. Butement. Nature 167, 400(1951) Mar. 10. (Letter to the editor)

A study of radioactive Sm and Pm has shown Pm^{145} to have a half life of ~30 yr. Very pure Sm_2O_3 was irradiated in a neutron flux of 10^{12}/cm^2/sec for 28 days and then was kept for 206 days to allow for growth of Pm^{145} and the decay of short-lived Sm isotopes. Apparently, Sm^{145} decays by orbital electron capture, with a half life of 410 days, into Pm^{145} which also decays by orbital electron capture into stable Nd^{145}.

5971
ABNORMAL RADIATION ACCOMPANYING β DISINTEGRATION. Jean Thibaud. Compt. rend. 232, 362-4(1951) Jan. 22. (In French)

The presence in β decay of negative particles having the charge of an electron but exceptionally high momentum ($H\rho$ = 12,000 to 25,000 oersteds/cm) is concluded from the results of prolonged exposure of intense β sources (RaC (Bi^{214}), RaE (Bi^{210}), and P^{32}) in a β spectrograph with a weakly inhomogeneous field. Intensity of the photographic traces of this radiation was 10^{-4} to 10^{-5} that of the electron spectrum. This paper appeared in incorrect form in Compt. rend. 231, 1469-71(1950) Dec. 18; the present article is the complete, corrected text.

5972
COINCIDENCE STUDIES ON THE RADIATIONS FROM Ba^{131}. W. H. Cuffey. Phys. Rev. 82, 461-2(1951) May 1. (Letter to the editor)

Experiments were performed to obtain more information about the γ rays from Ba^{131}. The absorption curve in Pb shows three γ-ray groups at energies 0.16, 0.42, and 1.2 Mev. Other γ rays were shown by the absorption curve in Al and the coincidence absorption curve of Compton electrons ejected from a brass radiator by the γ rays. These experiments establish 0.83 Mev as a lower value for the highest energy γ ray.

5973

RADIOACTIVITY OF CERIUM. R. D. Hill. Phys. Rev. 82, 449(1951) May 1. (Letter to the editor)

A search for further isomers at the end of the 5th nuclear shell has led to a reinvestigation of the activities of Ce^{137} and Ce^{139}. Within the experimental limitation of a lifetime greater than about a day, no isomeric activity was observed. Samples of Ce isotopes were bombarded by neutrons in the Oak Ridge and Argonne piles and the resulting observed γ transitions of Ce^{141} and Ce^{143} are discussed.

5974

EVIDENCE FOR THE FORMATION OF POSITRONIUM IN GASES. Martin Deutsch. Phys. Rev. 82, 455-6(1951) May 1. (Letter to the editor)

Evidence of the abundant formation of positronium is given. Numerous measurements were made of time delays between the emission of a nuclear γ ray from the decay of Na^{22} and the appearance of an annihilation quantum for positrons in various gases.

5975

THE ENERGY AND ANGULAR DISTRIBUTION OF THE GAMMA-RAYS FROM THE REACTION $Li^7(p, \gamma)$ Be^8. H. Nabholz, P. Stoll, and H. Wäffler. Phys. Rev. 82, 963-4 (1951) June 15. (Letter to the editor)

The γ rays from the 17.6-Mev state of the Be^8 nucleus have been analyzed by means of the $C^{12}(\gamma, \alpha)2\alpha$ reaction. The plot of the number of stars as a function of total energy of the 3α particles shows two groups, associated with the 17.6-and 14.7-Mev γ lines from transitions to the ground and to the first-excited state in Be^8, and a very weak third group corresponding to a γ line of about 12.6 Mev which in turn relates to a 5-Mev (apparently the known 4.9-Mev) state of Be^8. Approximately 10% of the transitions from the resonant 17.6-Mev state seem to lead to the 4.9-Mev state of Be^8. In addition, the angular distribution of the γ rays was measured and found to be isotropic for both the 17.6- and 14.7-Mev components.

5976

NEUTRON DEFICIENT ISOTOPES OF LANTHANUM. M. M. Gransden and W. S. Boyle. Phys. Rev. 82, 447(1951) May 1. (Letter to the editor)

A Ba target bombarded by protons with energies up to 90 Mev has been found to yield the new isotopes La^{132} (4.5-hr) and La^{131} (58-min) which were isolated by a 180° mass spectrograph.

5977

ON THE THEORY OF BETA-DECAY. R. J. Blin-Stoyle and J. A. Spiers. Phys. Rev. 82, 969-70(1951) June 15. (Letter to the editor)

It has been found possible to write the matrix elements of standard β-decay theory in a way which not only gives the β spectra and angular distributions for arbitrary degree of forbiddenness, but also yields very simply the selection rules appropriate to any chosen type of interaction. 2 tables.

5978

COMPLEX ALPHA-SPECTRUM OF U^{235}. A. Ghiorso. Phys. Rev. 82, 979(1951) June 15. (Letter to the editor)

A 48-channel differential α-pulse analyzer has been used to resolve the α-particle radiation emitted by U^{235} into at least three groups. By comparison with a pulse analysis of radioactively pure samples of U^{234} and U^{238}, it can be shown by a process of elimination that the isotope U^{235} is responsible for the peaks at 4.58, 4.40, and 4.20 Mev, with respective relative abundances of 10.2, 85.6, and 4.2%, and partial α half lives of 6.99×10^9, 8.33×10^8, and 1.70×10^{10} yr.

5979

GAMMA-TRANSITIONS IN THE DISINTEGRATION OF CERIUM 144. W. S. Emmerich, G. John, and J. D. Kurbatov. Phys. Rev. 82, 968(1951) June 15. (Letter to the editor)

The disintegration of Ce^{144} has been investigated by studying the internal conversion electrons in a permanent-magnet spectrograph set at 104 and 179 gauss, covering an energy range from 10 to 400 kev. The energy difference between six conversion electrons corresponds closely to the difference in binding energy in praseodymium, and the transitions are ascribed to this element. Identification of other observed conversion electrons in Pr^{144} is less certain, but tentative assignments are made. The energy balance for all observed levels in Pr up to 175 kev has been considered.

5980

CONTINUOUS γ RADIATION OF β EMITTERS. L. Madansky and F. Rasetti. Phys. Rev. 83, 187-8(1951) July 1. (Letter to the editor)

An investigation has been made of the continuous γ radiation from 30 to 300 kev emitted in the β decay of P^{32} and RaE (Bi^{210}). The γ radiation was measured by means of NaI(Tl) crystals, a 5819 phototube, a linear amplifier, and a one-channel discriminator. For P^{32}, the energy emitted in the form of γ radiation was 3.2×10^{-3} mc^2 per β. For RaE the number of γ quanta above 90 kev was 1.6×10^{-3} per β. Both the total intensity and the spectral distribution showed no significant discrepancy with the theory.

5981

A HIGH ENERGY γ-RAY LINE IN THE SPECTRUM OF Mg^{24}. L. E. Beghian, G. R. Bishop, and H. Halban. Phys. Rev. 83, 186-7(1951) July 1. (Letter to the editor)

In a further investigation of the γ-ray spectrum of Mg^{24}, an ionization chamber containing D_2 gas was used with a linear amplifier, and the output was examined with a 25-channel kicksorter. A high-energy photoproton peak, corresponding to a γ-ray energy of 3.62 ± 0.05 Mev, was resolved from the γ-ray background. The intensity of the line was 1 in 2500 ± 250 disintegrations. The possibility that the new line may be due to a transition from the 4.14-Mev level to a new level at 400 ± 100 kev is excluded, and if it is due to a transition from a new 3.7 ± 0.1-Mev level to the ground state, all spin and parity assignments for the 3.7-Mev level can be excluded except 2^+ or 2^-, or values above 7 for the spin. An upper limit of 2×10^{-6} photons/disintegration is calculated for the intensity of the 4.14-Mev γ line.

5982

THE DETERMINATION OF THE DECAY CONSTANT OF A RADIOACTIVE SOURCE. N. Hole. Kgl. Norske Videnskab. Selskabs Forh. 23, 30-3, 34-7, 62-5(1950).

Probability-theoretical procedures for the calculation of the decay constant k are discussed, in which, using the method of maximum likelihood, estimates of k are made, and the exact distribution of such estimates is established. In one problem the calculation is made from observations of the time of occurrence of all disintegrations which took place during a given time interval T; in another, T is supposed to be divided in r equal intervals, and the number of disintegrations observed in these intervals is given.

5983

THE WAVE STATISTICAL THEORY OF ALPHA-DISINTEGRATION. K. C. Kar and M. L. Chaudhury. Indian J. Phys. 24, 545-65(1950) Dec.

This paper studies the phenomenon of alpha-decay from a completely new standpoint. According to this theory the alpha particles do not leak through the potential barrier by some unknown mechanism, but actually surmount the barrier as

required by classical mechanics, and on coming out of the nucleus they are acted upon by a retarding attraction field of Yukawa type, which will obviously reduce the initial high energy to the low observed value.

5984
THE BETA SPECTRUM OF TRITIUM. G. M. Insch and S. C. Curran. Phil. Mag. 42, 892-9(1951) Aug.

The beta-spectrum of tritium, H^3, has been carefully examined by the proportional counter method down to energies ~1 kev. In the present work it has been more thoroughly explored using improved techniques designed to permit accurate measurements of the spectrum shape down to a lower energy limit ~200 ev. The improvements consisted chiefly in employing a counter which was made "end-free" by means of field-adjusting tubes and the use of an electronic method of measuring the pulse distribution in addition to the moving film technique. The intensity of the spectrum below 1 kev was found to be definitely less than theoretically predicted. (auth)

SPECTROSCOPY

5985
ON THE ISOTOPIC SHIFT IN THE Gd I SPECTRUM. Peter Brix and Hans Dietrich Engler. Naturwissenschaften 38, 214(1951) May. (Note; in German)

Anomalously large ratios between the experimental and the theoretical values of isotopic shifts in Ce, Sm, and Eu have been attributed (Brix et al., Z. Physik 126, 344(1949); 127, 289(1950)) to nuclear peculiarities of these elements, viz., (1) to the new neutron shell which is beginning to form after the neutron number 82 has been reached, and (2) to the rapid change in quadrupole moments. In order to eliminate the possible objection that the 4f electrons can also be responsible for the anomalous effect, an experimental comparison was made of the hyperfine structure of Eu I and Gd I whose electronic configurations contain the same number of 4f electrons ($4f^76s^2$ and $4f^75d6s^2$, respectively); no anomalously large isotopic shifts were found in the Gd spectra.

5986
HYPERFINE STRUCTURE OF Sm^{149}, Sm^{147}, Nd^{145}, and Nd^{143}. Kiyoshi Murakawa and John S. Ross. Phys. Rev. 82, 967-8(1951) June 15. (Letter to the editor)

The hyperfine structure of the spectra of samarium and neodymium was studied with a silvered Fabry-Pérot etalon and a Hilger constant-deviation prism spectrograph. The calculations of spin and magnetic moment are outlined. The spin of Sm^{149} and of Sm^{147} is 5/2, and that of Nd^{145} and of Nd^{143} is 7/2; the magnetic moments are respectively -0.25 ± 0.04, -0.30 ± 0.05, -0.62 ± 0.09, and -1.0 ± 0.2 nm.

THEORETICAL PHYSICS

5987
Ames Lab.
TRANSITION PROBABILITIES II. CALCULATION OF SEMITHEORETICAL f-NUMBERS FOR HYDROGEN USING THE DIPOLE VELOCITY OPERATOR. Harrison Shull. Aug. 10, 1951. 16p. (ISC-159)

The computations of Mulliken and Rieke using the LCAO Mo and the AO methods for transition probabilities of the Lyman ($^1\Sigma_g^+ - {}^1\Sigma_u^+$) and Werner ($^1\Sigma_g^+ - {}^1\pi_u$) transitions in H have been repeated using the alternative velocity form of the transition moment operator. It is found that, for an effective Z value of 1.2 for the 1s AO (the variation value) and a suitable Rydberg form for the excited state, the transition probabilities calculated from these two operators agree well. In addition there is quite good agreement between the AO and MO methods in each instance and between the calculated and experimental value for the sum of the strengths of the Lyman and Werner transitions. (auth)

5988
A QUANTUM MECHANICAL TREATMENT OF THE LITHIUM FLUORIDE CRYSTAL. G. C. Benson and G. Wyllie. Proc. Phys. Soc. (London) 64A, 276-82(1951) Mar.

A simplified quantum-mechanical model for the LiF crystal is described. The lattice parameter, cohesive energy, and compressibility are calculated using three different choices of wave function for the fluorine ion in the crystal; these are (1) the Hartree wave functions for the free ion F^-, (2) wave functions orthogonalized to the 1s-orbitals of the six nearest neighbor lithium ions, (3) functions similar to (2) but based on wave functions for the free ion which have been contracted to give agreement with the diamagnetism of F^-. The results obtained in (1) are in fair agreement with the empirical values. Large discrepancies are observed when the more complete wave functions (2) are employed. This is taken as indicating that the Hartree wave functions for the free ion are too diffuse, and the results of the third calculation, which agree well with experiment, substantiate this interpretation.

5989
THE MOTION OF THE CENTER OF GRAVITY AND THE WIDTH CHANGES IN WAVE PACKETS. R. V. Serebryanyĭ. Zhur. Eksptl'. i Teoret. Fiz. 20, 1130-8(1950) Dec. (In Russian)

The motion of a limited wave packet in a homogeneous isotropic medium is examined for an arbitrary dispersion law. The packet's width changes as the square of the time, and its center of gravity moves with a uniform velocity. For a nonplane packet in a medium without dispersion, this velocity is smaller than the phase velocity of the component plane waves, whereas for an electromagnetic packet the velocity is equal to that of a particle whose momentum and energy are those of the packet. (auth)

5990
NUCLEAR PHOTOEFFECT IN BERYLLIUM. Otto Bergmann. Acta Phys. Aust. 4, 338-54(1951) May. (In German)

On the basis of the two-body model, the cross-section formula for the reaction Be^9 (γ,n) is derived and discussed. If it is assumed that in all states the effective range of the force is equal to $r = 5 \times 10^{-13}$ cm, the well depth in the ground state is found to be 12.09 Mev, and in the final continuous states 3.3 Mev. (auth)

5991
A NEW VARIANT OF THE THEORY OF ELECTRON-POSITRON PAIRS. Ya. I. Frenkel. Zhur. Eksptl'. i Teoret. Fiz. 21, 466-72(1951) Mar. (In Russian)

An attempt is made to deduce a law of conservation of the number of elementary particles by using the "classical" picture of a negatron and a positron as two small spheres carrying opposite charges which, in accordance with the electro-magnetic theory, are determined by the spheres' mass m_0. It is assumed that, besides the case of a relative motion of the two spheres with respect to each other (as in an oscillation), the spheres can totally coincide in space and move as a whole; whereas in the former case the total mass is $2m_0$, in the latter case it is zero. With this model, the polarization of the vacuum is easily explained by a deformation of the coinciding pair through the action of an external electric field. However, a total separation of the pair, which could be expected from the interplay of the same forces, is difficult to establish theoretically; a quantum-theoretical analysis of the problem meets with fundamental contradictions. A more consistent quantum mechanics will, perhaps, be able to remove these difficulties.

5992

COMPATIBILITY OF EQUATIONS OF THE UNIFIED THEORY OF FIELDS. Marie-Antoinette Tonnelat. Compt. rend. 232, 2407-9(1951) June 25. (In French)

Equations of a unified field given by the author in Compt. rend. 230, 182(1950) imply an affinity connection whose compatibility with the equations is not a priori certain. The question of compatibility is examined, and cases where the compatibility condition is satisfied are pointed out.

5993

METHODS OF SECOND QUANTIZATION AND OF CONFIGURATION SPACE IN THE RELATIVISTIC THEORY OF PARTICLE SYSTEMS. III. DERIVATION OF RELATIVISTIC EQUATIONS FOR PARTICLES IN INTERACTION. Maurice Jean. Compt. rend. 232, 2405-7(1951) June 25. (In French)

Methods proposed in former notes (Compt. rend. 232, 1183, 1200(1951)) as suitable for the construction of a Fock representation of a state vector in the quantum theory of fields can be extended to fields in interaction. As a special case, relativistic equations for particles in interaction and, more particularly, the problem of two nucleons in meson theory are examined.

5994

ON THE THEORY OF BETA-RADIOACTIVITY. Hendrik Anton Tolhoek. Thesis, University of Utrecht, 1951. 77p.

Chapter I deals with the theory of allowed β transitions, if a linear combination of the five relativistic invariants is taken for the β interaction. The β spectrum, the electron-neutrino angular correlation, and the K capture are considered. Chapter II is concerned with a theoretical discussion of the representation of the polarization of electron beams by a density matrix and a discussion of some notions on polarized electron beams, such as the degree of polarization. In Chapter III the influence of slowly varying electric and magnetic fields on the polarization of electron beams has been calculated. Chapter IV gives the theory of the polarization of the β rays emitted by aligned nuclei in allowed transitions. The theory is again developed using a hamiltonian for the β interaction, which is a linear combination of the five relativistic invariants.

5995

CORPUSCULAR ASPECT OF MATTER. Ya. I. Frenkel'. Uspekhi Fiz. Nauk 44, 110-16(1951) May. (In Russian)

In its original form (de Broglie and Schroedinger, 1924-1925) wave mechanics was not dualistic; it was purely undulatory, yet wave packets were there to simulate particles. However, the packets were spreading and (in diffraction) splitting entities. This deficiency in "materiality" of wave structures compelled Born (1926) to fall back to familiar atomistics and to assign the wave function a mere statistical nature; this was done at the price of postulating a double matter-or-wave face to physical reality. Arguments are presented here against this attitude. It is proposed to do away with any corpuscular images and to make a new attempt at viewing all material phenomena in the light of a theory of a quantized wave field. This can be readily done in cases where, in terms of the conventional quantum mechanics, a single particle, or an aggregate of noninteracting particles, define the picture: thus, by properly choosing among refraction indices, an adequate expression for the potential energy of an electron in a Coulomb field will be found; or by introducing a total reflexion with an imaginary component of the wave vector, a wave picture of the tunnel effect will be given. For the more difficult case of a system of particles in interaction, it is suggested that Mott's treatment of the wave mechanics of α-ray tracks (Proc. Roy. Soc. (London) 126A, 79(1929)) be taken into consideration. Mott has shown that the rectilinear shape of a cloud-chamber track can be deduced from the properties of a wave function describing, in a multidimensional configuration space, the given α particle together with the atoms of air filling the chamber; these atoms are assumed to be in various excitation and ionization states. Since the existence of linear tracks has always been considered a direct testimony in favor of the reality of material particles, it is significant that Mott's proof can be construed as an example of purely undulatory interpretations of tracks or of any other phenomena hitherto explained by interactions of particles.

5996

DOES THE PARTICLE-WAVE "DUALISM" ALWAYS EXIST? D. I. Blokhintsev. Uspekhi Fiz. Nauk 44, 104-9 (1951) May. (In Russian)

The quantum-mechanical principle of the equivalence of corpuscular and undulatory representations of physical reality is based (1) on the definition of a particle as an excited state of a field whose energy, during possible interactions, is exchanged in quantized parcels, and (2) on the assumption that in all fields interactions actually proceed by quanta. It is shown here that certain field interactions cannot be quantized and, consequently, are not related to any corpuscular properties. In the two illustrations examined interactions between fields ϕ and ψ are defined respectively by $W = g\psi\phi$ and $W = g\psi\phi^2/2$, where W is the interaction energy and g the coupling constant; the quantization is found to be incompatible with certain values of g. It is suggested that the neutrino may lack corpuscular properties.

5997

ON THE NUCLEON CASCADE WITH IONIZATION LOSS. H. Messel. Phys. Rev. 83, 21-5(1951) July 1.

The fundamental equations for a nucleon cascade including ionization loss are given. Solutions satisfying the exact boundary conditions are found in a manner similar to that used by Bhabha and Chakrabarty for the electron-photon cascade. However, in the present treatment, second-order equations are not resorted to and all four cases (protons producing protons and neutrons; neutrons producing protons and neutrons) are treated simultaneously. The results are given in tabular and graphic form and can be adapted easily to any specific problem. A number of examples showing the effect of ionization loss have been computed and the ratio of neutrons to protons given. The calculations are carried out using the cross section formulated by Heitler and Jánossy. (auth)

5998

THE ANGULAR CORRELATION THEOREM AND THE ELIMINATION OF INTERFERENCE TERMS. H. A. Tolhoek and S. R. de Groot. Phys. Rev. 83, 189-90(1951) July 1. (Letter to the editor)

With the use of a density matrix a theorem is proved which permits the avoidance of certain interference terms in theoretical considerations on angular correlations. The theorem of Falkoff and Uhlenbeck (Phys. Rev. 79, 323(1950); NSA 4-5535) is a special case of this theorem.

5999

HEISENBERG OPERATORS IN QUANTUM ELECTRODYNAMICS. I. F. J. Dyson. Phys. Rev. 82, 428-39(1951) May 1.

A new analytic continuation principle is described, by which the calculation of matrix elements of Heisenberg operators in any quantized field theory is greatly simplified. By a "Heisenberg operator" is meant an average over a finite space-time region of a field operator in the Heisenberg representation of the theory. The analytic continuation is made by varying the characteristic masses of the fields through real values. In this way a Heisenberg operator with the physically occurring masses is derived

from an operator calculated with very large fictitious masses. In the region of large masses, where real creation of particles is impossible, the operator is identical with the S-matrix for a suitably chosen scattering problem.

6000
A SYMMETRY PRINCIPLE IN THE FERMI THEORY OF BETA-DECAY. George L. Trigg and Eugene Feenberg. Phys. Rev. 82, 982(1951) June 15. (Letter to the editor)

Consideration is given to a general interaction operator for β decay in the form $V = G \sum_{k=1}^{5} \left[C_k V_k + C_k^* V_k^* \right]$. In a theory containing only one invariant operator V_k the phase of the coupling constant C_k has no physical consequences. Conventionally C_k is taken real. In the general theory containing linear combinations the relative phases of the C_k's enter directly into the transition probabilities and influence the half lives and energy distributions. The conventional choice of real coupling constants then appears to be without physical justification. Report is made on some consequences of permitting arbitrary relative phases.

6001
THE RELATIVE PHASE OF THE INTERACTION CONSTANTS FOR MIXED INVARIANTS IN BETA-DECAY. L. C. Biedenharn and M. E. Rose. Phys. Rev. 83, 459 (1951) July 15. (Letter to the editor)

The most general formulation of the (point) β-interaction involves an arbitrary mixture of the five invariants S, V, T, A, P formed by contracting bilinear covariants of the lepton and nuclear fields. It is customary to assume real mixing (interaction) constants and, since complex constants can have an effect on the predicted results of the theory, the question arises as to whether the usual assumption of real constants is an unwarranted restriction. This question is considered, and it is concluded that the assumption of real constants is in fact no restriction on the theory.

6002
QUANTUM MECHANICS OF PARTICLES AND WAVE FIELDS. Arthur March. New York, John Wiley & Sons, Inc., 1951.

Intended as a text and summary for the modern physicist, this book first reviews principles of quantum mechanics and then attacks some of the unexplained newer problems with which other texts have not dealt. Professor March's book attempts to interpret the meaning of "field" in the new mechanics. Special care has been taken to acquaint the reader with the mathematical formalism of relativistic quantum mechanics. Specifically, the author discusses wave mechanics of single- and many-particle systems, stationary states and matrix form, perturbation theory, quantization of wave fields, and quantum electrodynamics. Finally he introduces the idea of fundamental length in an effort to eliminate the difficulties which arise when the principles of quantum mechanics are applied to electromagnetic fields. The fundamental length is shown to be of similar significance to Planck's constant, h, and the light velocity constant, c.

A more complete review by C. W. Hargens may be found in J. Franklin Inst. 252, 270(1951) Sept.

6003
CASCADE THEORY INCLUDING IONIZATION LOSS. L. Jánossy and H. Messel. Proc. Phys. Soc. (London) 64A, 1-4(1951) Jan.

The Bhabha-Chakrabarty solution (Proc. Roy. Soc. (London) 181A, 267(1943); Phys. Rev. 74, 1352(1948)) of the cascade equations with ionization loss is discussed, and a simplified method of numerical evaluation is suggested. (auth)

6004
ON THE RENORMALIZATION OF QUANTUM ELECTRODYNAMICS. J. C. Ward. Proc. Phys. Soc. (London) 64A, 54-6(1951) Jan.

The subtraction procedure of Dyson (Phys. Rev. 75, 1736(1949)) is modified in order to eliminate a certain difficulty in the renormalization program, namely the so-called "b" divergencies. The conclusions of Dyson concerning the finiteness of the renormalized S matrix are confirmed. (auth)

6005
THE POLARIZABILITY OF THE PROTON. J. Géhéniau and R. Servranckx. Acad. roy. Belg., Bull. classe sci. (5) 37, 138-45(1951) Feb. 3. (In French)

In the framework of the pseudoscalar meson theory, the self-energy of the proton in a uniform constant electromagnetic field is calculated up to terms proportional to the square of the field. It is shown that, after the renormalization of the mass, those terms of the self-energy, which are proportional to the square of the field, are finite. No renormalization of the charge is required. (auth)

6006
ON THE PARTICLE PICTURE OF QUANTIZED BOSE FIELDS. PART I. J. Leite Lopes. Anais acad. brasil. cienc. 23, 39-60(1951) Mar. 31.

In the light of recent developments in quantized-field theories, a revision is made of the work by Fock (Z. Physik 75, 622(1932)) on the equivalence between the method of second quantization and the treatment of the many-particle problem in configuration space. From the standpoint of relativistically covariant formulation, the cases of a free scalar and a pseudoscalar meson field are examined.

6007
A NEW DEFINITION OF THE HERMITICITY OF THE QUADRIOPERATOR $-(h/2\pi i)\partial^k$. Olivier Costa de Beauregard. Compt. rend. 232, 214-16(1951) Jan. 15. (In French)

An application of a group of translations in space-time and Bochner's criterion of eigenfunctions permits the author to extend and improve his generalized definition and previous proof (Compt. rend. 225, 626(1947); 231, 1423(1950)). Application to Dirac's theory of the electron and extension to the theory of particles of arbitrary spin are discussed.

6008
ON SOME PHASE-POTENTIAL RELATIONS. Bengt Holmberg. Kgl. Fysiograf. Sällskap. Lund, Förh. 20, 49-57 (1950)

Froeberg (Arkiv Mat. Astron. Fysik 35A, No. 17; 36A, No. 11 (1948)) has treated the problem of determining the potential from the asymptotic phase in the radial Schroedinger equation for particle interactions. A generalization of Froeberg's first-approximation formula for a noncentral interaction is given here.

6009
MATRIX ELEMENTS FOR OCTUPOLE RADIATIVE TRANSITIONS. A. P. French. Phil. Mag. (7) 42, 263-6(1951) Mar.

During the analysis of some recent experiments on the angular correlation between α particles and γ rays (Nature 166, 145(1950)) it was necessary to find values of the matrix elements for certain octupole transitions. These were derivable from general formulas obtained by Fierz (Helv. Phys. Acta. 22, 489(1949)) by group-theoretical methods. Although Fierz deals with multipole radiation of any order, his formulas do not cover all possible transitions. If j represents the total angular momentum of the initial state, which goes over to a state of angular momentum $j + \Delta j$ with the emission of radiation of multipole order 2^l, then the

cases treated by Fierz are limited to $\Delta j = \pm 1$ or $\pm(l-1)$. It was thought to be of interest to extend calculations to all possible values of Δj for the particular case of octupole radiation, since radiation of this order (or even higher) seems to appear rather frequently in nuclear problems. The method used was a simple extension of that applied by Condon and Shortley (The Theory of Atomic Spectra, Cambridge, University Press, 1935) to the problem of quadrupole transitions.

6010
NOTE ON THE GENERAL THEORY OF SCATTERING. M. L. Goldberger. Phys. Rev. 82, 757(1951) June 1. (Letter to the editor)

A formulation of scattering theory in which the Heitler integral equation for the matrix R_{ba} and an integral equation for G_{ba} not on the energy shell $E_a = E_b = E$ are regarded as fundamental has several advantages over the usual presentation. The advantages are enumerated, and a variational basis is given for these equations.

6011
AN EQUIVALENCE THEOREM IN MESON THEORY. K. V. Roberts. Phys. Rev. 83, 188-9(1951) July 1. (Letter to the editor)

The different types of vertices which can occur in a Feynman-Dyson graph are known to correspond to the different terms in the Lagrangian for the charged scalar meson field interacting with the electromagnetic field. The two forms of the Lagrangian are not the same, in that only 3-vertices occur in one case and both 3-vertices and 4-vertices occur in the other case. This difference is compensated by a difference in the propagation factors associated with some of the lines, so that both formulations lead to the same S-matrix. Similar equivalence theorems hold in vector meson theory, etc.

6012
APPLICATION OF SYMBOLIC CALCULUS TO THE RESOLUTION OF DIRAC'S PERTURBATION METHOD. Michel Fabre de la Ripelle. Compt. rend. 232, 2403-5(1951) June 25. (In French)

The coefficients of the expansion used in the perturbation method are amplitudes of probabilities of finding the system in a given state at a given instant. These probabilities are replaced by corresponding image functions which are solutions of Laplace transforms of the foregoing expansion. The study of the probabilities of various states is performed in the image space.

6013
THEORIES OF HIGH-SPIN PARTICLES. P. Urban and F. Schwarzl. Acta Phys. Aust. 4, 380-404(1951) May. (In German)

Theories of high-spin particles, published before 1946, viz., works of Dirac, Fierz, and Bhabha, are presented in a general treatment, preceded by an exposition of the spinor analysis and of infinitesimal transformations.

6014
ENERGY LEVELS OF A VECTOR PARTICLE IN A PURE COULOMB FIELD. K. M. Case and A. M. L. Messiah. Phys. Rev. 82, 563(1951) May 15. (Letter to the editor)

In a recent paper (Case, Phys. Rev. 80, 797(1950)) it was shown that the Schroedinger equation for a Hamiltonian with singular potential can be made to yield a complete orthonormal set of solutions. In addition to the usual condition of quadratic integrability, the wave function is required to have a fixed behavior at the origin. This behavior is conveniently described by prescribing a phase β. Since the choice of β is rather arbitrary, it is of interest to know how sensitively the resulting spectrum depends on this parameter. The results of theoretical studies by the authors seem to indicate that, except for a small range of β of order αZ, where α is the fine-structure constant, the energy levels of a vector particle in a coulomb field are of order αZ the same as those given by the nonrelativistic theory. The shift of levels due to magnetic and relativistic effects is of higher order in αZ just as in the case of spin-0 and spin-½ particles.

6015
MAXIMUM RATE OF WAVE FUNCTION AMPLITUDE CHANGE. Rolf Landauer. Phys. Rev. 82, 549(1951) May 15. (Letter to the editor)

Brief note is made of a way of finding an upper bound to the rate at which a wave function envelope can change its amplitude. The method involves summing the absolute values of all the wavelets which contribute to the wave function and ignoring their phase differences. By interpreting the results of the summation, the author shows how to establish an upper bound for the rate of change.

6016
EXCITATION OF ATOMS BY ELECTRON COLLISION I. Hisashi Horie. J. Phys. Soc. Japan 6, 179-84(1951) May-June.

Racah's method is applied to the problem of excitation of atoms in complex configuration by electron collision. The configurations considered are l^n, $l^n l'$ and d^n. The general formulas are given for the transition probability of excitation by electron collision.

6017
ON THE ELIMINATION OF DIVERGENCIES FROM QUANTUM ELECTRODYNAMICS. Suraj N. Gupta. Proc. Phys. Soc. (London) 64A, 426-7(1951) Apr. (Letter to the editor)

An approach unlike that of Schwinger and Tomonaga is used to remove all divergencies from the S-matrix in quantum electrodynamics. It involves a more symmetrical treatment of the matter and the radiation fields. No charge renormalization is necessary in this treatment. A few remarks are made about the correspondence in the elimination of divergencies from classical and quantum electrodynamics.

6018
THE RENORMALIZATION METHOD IN QUANTUM ELECTRODYNAMICS. F. J. Dyson. Proc. Roy. Soc. (London) 207A, 395-401(1951) July 6.

A new technique has been developed for carrying out the renormalization of mass and charge in quantum electrodynamics, which is completely general in that it results not merely in divergence-free solutions for particular problems but in divergence-free equations of motion which are applicable to any problem. Instead of using a power-series expansion in the whole radiation interaction, the new method uses expansions in powers of the high-frequency part of the interaction. The convergence of the perturbation theory is thereby much improved. The method promises to be especially useful in applications to meson theory. (auth)

TRACER APPLICATIONS

6019
COEFFICIENTS OF THERMAL DIFFUSION OF S^{35} AND P^{32} IN SODIUM CHLORIDE. Marius Chemla. Compt. rend. 232, 2424-6(1951) June 25. (In French)

S^{35} and P^{32} formed through irradiation of a NaCl crystal with fast neutrons diffuse toward the surface of the crystal. The diffusion coefficient is found to vary with the temperature according to the law $D = D_0 \exp(-W/kT)$, where W is the activation energy, which is 1.90 ev for S^{35} and 3.30 ev for P^{32}. The movement of the ions is probably determined by the negative holes in the lattice. (auth)

PATENTS

BIOLOGY AND MEDICINE

6020

METHOD FOR MITIGATING RADIOACTIVE CONTAMINATION. Jack De Ment (to U. S. Atomic Energy Commission). U. S. Patent 2,563,587, Aug. 7, 1951.

In accordance with the method of this patent, radioactive contamination is removed from an object by applying a hydrolyzable silicon compound and exposing the object to moisture whereby the compound is hydrolyzed and then removing the hydrolyzed compound and the radioactive contamination adsorbed therein.

6021

SHIELDED CONTAINER. J. F. Gifford (to U. S. Atomic Energy Commission). U. S. Patent 2,563,718, Aug. 7, 1951.

This patent describes a shielded container for use in storing, handling, and transporting radioactive materials. The device is provided with a simple and effective locking means for a series of container trays.

CHEMISTRY

6022

PROCESS FOR PHOTOCHEMICAL CHLORINATION OF HYDROCARBONS. W. S. Beanblossom (to U. S. Atomic Energy Commission). U. S. Patent 2,566,052, Aug. 28, 1951.

In accordance with the process disclosed in this patent, chlorinated paraffinic hydrocarbons of 5 or more carbon atoms in which a major portion of the hydrogen atoms have been replaced by chlorine are produced by subjecting the starting hydrocarbon, under actinic light, to the action of chlorine diluted with hydrogen chloride during the initial stage of the reaction and to the action of undiluted chlorine during the remainder of the reaction.

6023

PROCESS FOR PHOTOCHEMICAL CHLORINATION OF HYDROCARBONS. A. Loverde and W. S. Beanblossom (to U. S. Atomic Energy Commission). U. S. Patent 2,566,065, Aug. 28, 1951.

This patent concerns a process for the photochemical chlorination of hydrocarbons of the alkyl-substituted single-carbon-ring type, such as toluene, xylene, etc., to replace a major proportion of the hydrogen atoms in their chains with chlorine. For each hydrocarbon the process is conducted in a temperature range where the reaction of chlorine with the hydrocarbon starts spontaneously and proceeds rapidly and smoothly and with little or no darkening of the reaction mixture.

6024

PRODUCTION OF XYLENE HEXAFLUORIDE. B. H. Wojcik and A. H. Maude (to U. S. Atomic Energy Commission). U. S. Patent 2,562,159, July 24, 1951.

This patent discloses an improved method for producing xylene hexafluoride from xylene hexachloride and hydrogen fluoride wherein the effective capacity of the autoclaves used for the reaction is increased severalfold.

6025

METHOD OF MAKING HALOCARBON POLYMERS. W. T. Miller (to U. S. Atomic Energy Commission). U. S. Patent 2,564,024, Aug. 14, 1951.

Polymers consisting substantially of carbon and halogen and containing high proportions of fluorine are prepared, according to the teachings of this patent, by heating compounds such as trifluoromonochloroethylene or the difluorodichloroethylenes in the presence of elemental oxygen as a polymerization promoter and at a temperature of about 60 to 100°C.

6026

ELECTRICAL CONTACT FOR ELECTROLYTIC CELLS. S. G. Osborne (to U. S. Atomic Energy Commission). U. S. Patent 2,562,150, July 24, 1951.

The invention described in this patent relates to a method for forming a corrosion-resistant joint between the contact surfaces of a carbon anode and a metal support of an electrolytic fluorine cell.

6027

VACUUM DISTILLATION. T. I. Taylor (to U. S. Atomic Energy Commission). U. S. Patent 2,562,153, July 24, 1951.

This patent describes a new method and apparatus for high vacuum or molecular distillation wherein the distilland flows filmwise down a substantially vertical evaporating surface, and the condensate collected on a rotating condenser is thrown upwardly and back upon the evaporating surface by centrifugal means.

6028

METHOD AND APPARATUS FOR CONTROL OF BOUNDARY BETWEEN ELECTROLYTIC FLUIDS. L. G. Longworth (to U. S. Atomic Energy Commission). U. S. Patent 2,563,729, Aug. 7, 1951.

This invention relates to an apparatus for automatically regulating the position of the ionic boundary in a liquid medium containing dissolved ions undergoing countercurrent electromigration. An important feature of the invention resides in the combination of a pair of control electrodes inserted in the electrolytic system in a plane normal to the direction of the electrolyzing current and means responsive to the conductivity of the fluid at these electrodes for controlling the addition of a fluid to the system.

6029

EXTRACTION PROCESS FOR CERIUM. J. C. Warf (to U. S. Atomic Energy Commission). U. S. Patent 2,564,241, Aug. 14, 1951.

In accordance with this patented invention cerium is separated from the other rare-earth elements and other materials by extracting it in its tetravalent state from an acid solution containing a salting-out agent by means of a water-immiscible alkyl phosphate.

6030

ZIRCONIUM AND HAFNIUM SEPARATION PROCESS. E. H. Huffman and L. J. Beaufait, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,566,665, Sept. 4, 1951.

Zirconium and hafnium are separated, in the disclosed process, by extracting an aqueous solution containing water-soluble salts of these elements with a water-immiscible solution containing a beta diketone, thenoyltrifluoroacetone; the zirconium is chelated and extracted into the water immiscible phase.

6031

PREPARATION OF URANIUM BROMIDE. J. E. Powell (to U. S. Atomic Energy Commission). U. S. Patent 2,562,122, July 24, 1951.

This patent discloses the preparation of uranium tetrabromide by reacting uranium dioxide with carbon disulfide and a brominating agent, such as bromine at a temperature in the range of 600 to 800°C.

ENGINEERING

6032

METHOD AND APPARATUS FOR PUMPING CORROSIVE MEDIUMS. H. S. Brown and H. H. Hubble (to U. S. Atomic Energy Commission). U. S. Patent 2,502,074, Mar. 28, 1950.

This patent describes a liquid-piston-type pump adapted for automatically pumping, compressing, or transferring fluorine gas, wherein the pumping fluid is liquid hydrogen fluoride containing a dissolved fluoride salt such as potassium fluoride.

MINERALOGY, METALLURGY, AND CERAMICS

6033

PRODUCTION OF PURE DUCTILE VANADIUM FROM VANADIUM OXIDE. R. K. McKechnie and A. U. Seybolt (to U. S. Atomic Energy Commission). U. S. Patent 2,561,526, July 24, 1951.

Ductile vanadium is prepared in accordance with the described invention, by reacting a mixture of vanadium pentoxide and iodine with an excess of metallic calcium and then separating the massive body of vanadium from the slag produced in the reaction.

PHYSICS

6034

ION SOURCE. F. S. Stein (to U. S. Atomic Energy Commission). U. S. Patent 2,563,626, Aug. 7, 1951.

The improved ion source described in this patent is useful in mass spectrometers, particularly such as apparatus for leak detection wherein helium is employed as a probe gas. The ion source is designed so that a magnetic field causes the electrons to traverse a spiral path and thereby increase the degree of ionization.

6035

ELECTRICAL SCALING CIRCUIT. B. Schloss and S. Robinson (to U. S. Atomic Energy Commission). U. S. Patent 2,562,645, July 31, 1951.

This patent covers a multiple scaling circuit comprising a plurality of scaling stages connected in cascade, each stage giving a single output pulse for every pair of successive input pulses, the pulses having an optimum wave form, whereby spurious pulses are minimized and the stability of adjustment is improved.

6036

POSITION INDICATING CONTROL APPARATUS. C. W. Park and J. C, Kilpatrick (to U. S. Atomic Energy Commission). U. S. Patent 2,562,637, July 31, 1951.

This invention relates to an improved electrical circuit-control apparatus which provides a remote-control action together with means indicating the accomplishment of the control action. The device was designed primarily for changing the range of an electrometer and positioning a probe used in conjunction with a particle accelerator.

6037

SEGMENTED IONIZATION CHAMBER. C. A. Tobias (to U. S. Atomic Energy Commission). U. S. Patent 2,566,684, Sept. 4, 1951.

This patent describes a unique type ionization chamber for scanning the cross section of a beam of ionized particles whereby the relative density of the various portions of the beam are indicated. This chamber may also be employed to readily and accurately determine the center of the beam of ionized particles as well as the direction of the central axis of the beam.

6038

MEASURING DEVICE AND METHOD OF MEASURING. A. M. McMahan and A. H. Snell (to U. S. Atomic Energy Commission). U. S. Patent 2,564,626, Aug. 14, 1951.

This patent describes a method and apparatus for measuring neutron activity which utilizes an element that will undergo nuclear reactions and transmutation by neutron adsorption and radioactive decay to produce a different element having an electrical conductivity markedly different from that of the original element. This change in conductivity is utilized as a measure of the neutron activity or intensity to which the original element was exposed.